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STOPPING AIR POLLUTION AT ITS SOURCE

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CAP

Clean Air Program

Draft Regulation
Appendices 3-7



Ontario

Environment
Environnement

Jim Bradley, Minister/ministre

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CAP

Clean Air Program

Draft Regulation

APPENDICES 3 - 7

August 1990

PREFACE

In November 1987, the Ministry of the Environment released a discussion paper on a new Clean Air Program for Ontario entitled "Stopping Air Pollution at its Source." During a 90-day comment period a series of public and special interest group meetings were held throughout the Province and wide-ranging written submissions were made to the Minister.

The Draft Regulation of the Clean Air Program contains an overview document accompanied by several appendices which describe procedures and protocols in detail. The appendices are referenced and described below and in each volume. Copies of the documents can be obtained separately or as a package from:

Environment Ontario
Public Information Centre
135 St. Clair Avenue West
Toronto, Ontario
M4V 1P5

Telephone Number (416) 323-4321

The Ministry believes that asking the public for its opinions - and listening to them - is essential to the development of programs which are effective in protecting our environment. Therefore, province-wide public consultation activities are being planned over a 180-day period. During this time, the Ministry will hold meetings to explain its Clean Air Program and to seek out the views of interested parties.

All members of the public are encouraged to participate in the public consultation process and to respond to the Ministry's request for comments. The comments received will then be taken into account as the program is finalized.

Summary of CAP Documentation

The Clean Air Program Draft Regulation outlines the Ontario Ministry of the Environment's proposals for regulating stationary air emission sources in the Province. The contents of the Draft Regulation are presented in an overview document and three volumes of appendices. An additional volume summarizes the comments received by the Ministry on its 1987 Discussion Paper - "Stopping Air Pollution At Its Source." In order to assist in the reading of the documents the following summary of the contents of the various volumes is presented:

Draft Regulation Overview:

In this volume the key elements of the Clean Air Program are identified, and the way in which the Ministry is proposing that they should be integrated into a new regulatory package is specified.

Responses to Public Comments:

Comments received at public meetings, meetings with special interest groups, an open workshop, and in submissions as a result of the Discussion Paper are summarized, and references are provided as to how and where the comments have been incorporated into the Draft Regulation or reasons are supplied as to why this has not been possible.

Appendices 1 and 2

Appendix 1 - DEFINITIONS

Technical terms used in the overview document and in the other appendices are defined to facilitate the interpretation of these documents.

Appendix 2 - SOURCE REGISTRATION

Appendix 2-1 - SOURCE REGISTRATION RATIONALE

The purpose and intent of the proposed source registration scheme are identified.

*Appendix 2-2***SOURCE REGISTRATION LEGISLATION**

The anticipated scope of the proposed source registration scheme is outlined. The applicability of source registration, and the requirements on owners and operators, including thresholds, the proposed treatment of mixtures and trade names, and proposed exemptions are identified.

*Appendix 2-3***LISTS OF CHEMICAL SUBSTANCES FOR SOURCE REGISTRATION**

The list of chemicals which owners or operators will be required to consider when filing a source registration statement is provided. This list is presented (1) in alphabetical order, (2) by CAS number order with synonyms, and (3) by synonyms in alphabetical order.

*Appendix 2-4***CANADIAN STANDARD INDUSTRIAL CLASSIFICATION CODES**

A listing of the Canadian Standard Industrial Classification Codes accompanies the Lists of Chemical Substances for Source Registration which it is proposed should be dealt with in the initial phase, the second phase and the third phase.

*Appendix 2-5***SAMPLE REGISTRATION FORM**

A sample registration form is provided.

*Appendix 2-6***SAMPLE INSTRUCTIONS**

A sample of the instructions (from U.S. E.P.A. SARA Title III Section 313) is supplied.

*Appendix 2-7***SAMPLE EMISSION CROSS-REFERENCE**

A sample of the Emission Cross-Reference and Section 313 Final Rule (which includes a sample method for estimating releases) is provided.

Appendices 3-7*Appendix 3***IMPLEMENTATION OF THE CLEAN AIR PROGRAM**

The manner in which it is proposed to implement the Clean Air Program is provided.

Appendix 4 - APPROVALS

The details of the proposed approvals mechanisms under the Clean Air Program are provided.

Appendix 4-1 - APPROVALS PROCESS

The proposed requirements of the Ministry's air approvals process, under which certificates of approval to construct and operate will be issued, are specified together with basic information requirements for the process, and the manner in which it is proposed the process should operate.

Appendix 4-2 - GENERIC CERTIFICATES OF APPROVAL

The proposals to handle the granting of certificates of approval to sources which have minor impact on the environment, and have common characteristics which permit generic or class control limitations to be employed, are itemized. An example based on U.S. state regulations for dry-cleaning establishments is appended.

Appendix 4-3 - EXPERIMENTAL FACILITIES

Proposed measures for handling pilot plants, laboratories and prototypes are identified.

Appendix 5 - SMALL AND SPECIAL SOURCES

The Ministry's proposals for handling the approval of small and special sources are described.

Appendix 5-1 - SMALL SOURCE DESIGNATION LIMITS

The Ministry's suggested methodology for defining small sources, is provided, accompanied by a list of suggested small source designation limits for chemicals included in the source registration process.

Appendix 5-2 - CODES OF PRACTICE - CONCEPTUAL OUTLINE

Codes of Practice are suggested as a mechanism for handling the regulation of certain types of sources. These include sources not amenable to conventional control technologies, defined as necessary or unavoidable and/or conducted infrequently or for short time periods at a particular location. The general conditions which will be included in codes of practice and a sample for open burning are provided.

Appendix 6 - **CONTAMINANT CLASSIFICATION PROCESS AND AIR QUALITY STANDARDS**

The methodologies which are proposed for the contaminant classification process and the setting of air quality standards are discussed.

Appendix 6-1 - **OVERVIEW: CLASSIFICATION, REGULATORY STRATEGIES AND AIR QUALITY STANDARDS**

The role of classification and air quality standards in the Clean Air Program; definition of a target list of chemicals; the classification methods which will be used; features of the proposed "interim classification" system, including a "public participation in classification process"; and the general characteristics of the proposed system for defining regulatory strategies, criteria and standards are summarized.

Appendix 6-2 - **THE CLEAN AIR PROGRAM (CAP) GENERIC CLASSIFICATION PROCESS**

The types of information which will be considered in the process of classifying contaminants are identified.

Appendix 6-3 - **MINISTRY OF THE ENVIRONMENT CHEMICAL LEVEL-OF-CONCERN CLASSIFICATION PROCESS**

Details of the proposed Ministry of the Environment process for classifying contaminants are supplied. Three methods are identified: development of (1) "detailed" or (2) "preliminary" dossiers together with the use of the MOE detailed scoring system; and (3) the use of various jurisdictional and property information.

Appendix 6-4 - **PROPOSED INTERIM LIST OF CONTAMINANTS CLASSIFIED ON THE BASIS OF LEVEL-OF-CONCERN**

Included in this Appendix are a proposed classification of contaminants listed as emissions in certificates of approval over recent years, and priority chemicals believed to be in use in Ontario which have been identified under the Canadian Environmental Protection Act or by other recognized jurisdictions as being of concern.

Appendix 6-5 - **PART 1: PUBLIC PARTICIPATION IN THE CLASSIFICATION PROCESS**

The process whereby the public, industry, and interested parties will be able to contribute to the classification of contaminants, is detailed.

Appendix 6-5 - **PART 2: CHEMICAL DOSSIERS**

Details of the requirements concerning the submission of chemical dossiers are supplied, together with a manual describing the Chemical Evaluation Search and Retrieval System (CESARS) written by the Michigan Department of Natural Resources as part of a joint effort with the Province of Ontario.

Appendix 6-6 - **REGULATORY STRATEGIES: THE DECISION PROCESS**

A three-tier approach which the Ministry of the Environment is considering in order to produce air quality standards and chemical specific regulatory strategies is discussed.

Appendix 6-7 - **INTERIM AIR QUALITY STANDARDS**

The values which the Ministry is proposing to use in connection with the new modelling package in evaluating applications for certificates of approval are supplied. The lists are arranged according to the averaging period which will be used: 24 hour; 1 hour; 10 minute; irregular averaging times; and 1 year.

Appendix 7 - **EMISSION LIMITS AND APPROVALS**

The Ministry's proposed mechanisms for setting and listing emission limits for use in the certificate of approval process are provided.

Appendix 7-1 - **EMISSION LIMITS**

The emission limits for various processes which the Ministry is proposing should be appended to a final draft regulation and used in the certificate of approval process are discussed.

Appendix 7-2 - **GUIDELINE FOR DETERMINATION OF EMISSION LIMITS**

The policies and requirements of the Ontario Ministry of the Environment used in setting emission limits under the Clean Air Program are documented.

Appendix 7-3 - **THE EMISSION LIMIT-SETTING PROCESS**

The process for setting emission limits is outlined.

Appendix 7-4 - **REQUIREMENTS FOR UPSETS, STARTUPS,
SHUTDOWNS AND BYPASSES**

The conditions under which by-passing of air pollution control systems are not permitted are identified.

Appendix 7-5 - **VISIBLE EMISSIONS**

The Ministry's proposals concerning visible emissions are provided together with U.S. E.P.A. Regulations on Standards of Performance for New Stationary Sources which will be used as a basis for proposed regulatory changes.

Appendix 7-6 - **PUBLIC CONSULTATION PROVISIONS**

Proposed avenues for public discussion of emission limit setting and the issuance of certificates of approval are identified.

Appendices 8-11

Appendix 8 - **AIR QUALITY MODELLING**

An overview of the dispersion modelling requirements associated with the certificate of approval process is provided, including the manner in which the modelling should be applied.

Appendix 8-1 - **A GENERAL USER'S GUIDE FOR SOURCE
ASSESSMENT**

Details of the requirements concerning modelling are supplied.

Appendix 8-2 - **DETAILED DESCRIPTION OF THE FULL MULTI-SOURCE AIR QUALITY MODELLING TECHNIQUE FOR CALCULATION OF LOCAL AIR CONCENTRATIONS**

The modelling package which the Ministry is proposing is described in detail complete with equations.

Appendix 8-3 - **MODELLING SCHEDULE - METHODOLOGY FOR THE DETERMINATION OF METEOROLOGICAL PARAMETERS REQUIRED FOR THE FULL AIR QUALITY MODEL CALCULATIONS.**

The process for determining the meteorological inputs to the models is described.

Appendix 8-4 - **A USER'S GUIDE TO THE AIR QUALITY MODELLING SOFTWARE**

A guide is provided to facilitate the running of the computer programs associated with the dispersion modelling package.

Appendix 8-5 - **SUPPLEMENTARY CONTROL PROGRAMS**

The conditions under which the Ministry is proposing that supplementary control programs should be utilized under CAP are identified.

Appendix 9 - **SOURCE TESTING**

The general provisions which it is proposed should govern source testing programs under the revised regulatory structure are supplied.

Appendix 9-1 - **SOURCE TESTING CODE**

Ontario's source testing code, which is under revision, is referenced. It is proposed that the revised version of this code will be the standard reference for use with the revised regulation.

Appendix 9-2 - **SOURCE TESTING METHODOLOGIES IN OTHER JURISDICTIONS**

A list of reference test methods from the U.S., which it is proposed should be used in Ontario, is supplied.

Appendix 10 - AMBIENT AIR MONITORING

The general requirements concerning ambient air monitoring are identified.

Appendix 10-1 - AMBIENT AIR MONITORING APPROVED SAMPLING AND ANALYTICAL METHODS

The sampling and analytical methods approved by the Ministry for pre-operational and post startup ambient air monitoring are summarized.

Appendix 10-2 - ASSESSING THE IMPACT OF AIRBORNE CONTAMINANTS ON SOIL AND TERRESTRIAL VEGETATION

The Ministry's methodology for evaluating the effect of airborne contaminants on soils and vegetation are detailed as a standard measuring/assessment technique.

Appendix 11 - QUALITY ASSURANCE FOR THE CLEAN AIR PROGRAM

The general quality assurance requirements under the Clean Air Program concerning: continuous ambient air monitoring activities; continuous source emission monitoring activities; discrete ambient air monitoring activities; and discrete source emission monitoring activities are discussed

APPENDIX 3

IMPLEMENTATION OF THE CLEAN AIR PROGRAM

APPENDIX 3

IMPLEMENTATION OF THE CLEAN AIR PROGRAM

Two of the major goals of the Clean Air Program are to virtually eliminate the emission to air of toxic chemicals in Ontario and to exercise responsible environmental stewardship in the release of all other material.

The Ontario Ministry of the Environment recognizes the major economic and resource impact the Clean Air Program will have. In contrast, the Ministry believes that the environmental benefit of the program will outweigh the costs. Accordingly, the Ministry has sought a phased implementation of the program to obtain an immediate improvement in the air quality of Ontario, prudently and efficiently use Ministry resources and provide sufficient time to our industries to implement the control technologies required. To achieve these objectives, the Ministry has proposed to phase in the program on an environmental priority basis. Three phases are proposed. Phases will be driven by a schedule based on high Level-of-Concern chemicals (see Table). The contaminants associated with each phase are subject to change; a notice period will apply to changes in the schedule. Contaminants for Phase 2 and Phase 3 will be selected from the Level 1 and Level 2 contaminants respectively, as listed in Appendix 6-4.

TABLE: Implementation by Chemical

PHASE	CHEMICALS REGULATED
Phase 1	Acrylonitrile Benzene Carbon Tetrachloride Formaldehyde Vinylchloride Lead Manganese Dioxins and Furans
Phase 2	TBA
Phase 3	TBA

For each phase of implementation, proponents will be given the option of obtaining a certificate of approval to construct or to operate for the entire facility, using the preliminary Level-of-Concern classifications listed, or for individual sources of the phase-specified contaminants.

Phase 1 of implementation will begin with promulgation of the regulation. All new, modified and existing facilities emitting selected (Phase 1 tabled) chemicals must implement controls, designed to meet emission standards set by the Ministry after promulgation of the regulation. These emission standards will cover not only the designated substances but all contaminants emitted by such sources. An appropriate period will be allowed in order to enable the proponents to plan, order, receive and install the required control technology. During Phase 1 of implementation, source registration will permit Ministry consideration of the chemicals to be covered in the subsequent phases.

Chemicals identified for Phase 2 and Phase 3 implementation will regulated in a fashion identical to Phase 1. New, modified and existing sources will be required to control emissions and meet community Air Quality Standards. The proponents again will have the option of applying controls for all emissions on a facility basis or may control only those sources which emit chemicals covered by the applicable phase of the regulation.

Phase 2 and Phase 3 of the implementation will be identified prior to requirements for implementing controls.

APPENDIX 4

APPROVALS

APPENDIX 4-1

APPROVAL PROCESS

1. INTRODUCTION

The approvals process serves two environmental protection functions. It promotes the consideration of environmental impacts during the planning for operations which emit pollutants, and it provides the opportunity for enforcing conditions on the operators of sources.

2. TYPES OF APPROVALS

2.1 General

Certificates of approval may be issued for the following types of sources of emission:

- single source
- multiple sources
- a complete facility e.g. a foundry, a manufacturing plant.

It should be noted that any particular source may emit one contaminant or more.

2.2 Approvals are required for:

2.2.1 New Facilities or Sources:

- an approval to construct; and
- an approval to operate

2.2.2 Existing Facilities or Sources that are Proposed to be Physically Altered or Relocated:

- an approval to construct the physical alterations and to operate the altered source/facility, or
- a revision of the previously issued permit to operate)

2.2.3 Existing Facilities or Sources that are Proposed to Undergo a Process Change (e.g., Changes in Operational Parameters, Raw Material Change, Changes in Production Rate) Without any Physical Alterations to the Source:

- revisions of the previously issued approvals to construct and operate.

3. CERTIFICATES OF APPROVAL

The Approvals Director may issue several types of certificates of approval. These are described in outline in the following sections:

3.1 Certificate of Approval to Construct and Operate

- 3.1.1 A certificate of approval that allows both construction and operation of a source must be obtained prior to construction of the source. Before obtaining this permit to construct and operate, the owner/operator may only construct buildings, foundations, install piping and electrical wiring, but must not install equipment that may emit pollutants into the atmosphere, including: retrofit pollution control equipment; boilers, incinerators; open or vented tanks. All construction performed prior to obtaining a certificate of approval will be taken on at the proponent's risk. The Ministry may require changes to constructed facilities if the review of the application warrants them.
- 3.1.2 This certificate to construct and operate also is intended to address the normal, productive operation of a facility, process, piece of equipment or thing, as well as reasonably expectable operating periods such as startup, shutdown and designed bypasses. This certificate will include, but is not limited to, the following conditions:
- operational parameters considered necessary to ensure that the source/facility does not emit contaminants in excess of the stack emission limits set out in the permit to construct;
 - operation with due care at all times to prevent upsets or conditions which may lead to emissions greater than the emission limits;
 - preventive maintenance procedures;
 - process and emission control alarms and interlocks;
 - recording and reporting procedures to ensure that the preceding conditions are met and for auditing and inspection by the District Officer;
 - frequency and protocol for future emission testing;
 - startup, shutdown and emergency shutdown procedures to minimize emissions;
 - other special conditions on a case-by-case basis; and

- certificate expiry date.
- 3.1.3 The certificate to construct and operate will be time-limited in accordance with the expiry data set out as a condition on the certificate. All such certificates will have to be renewed every 10 years or at more frequent intervals as deemed necessary by the Approvals Director. Alteration of the approved sources will result in a need to re-evaluate the operation of those sources prior to the expiry date of the certificate to operate.
- 3.1.4 In certain cases, it may be necessary to issue a certificate of approval to construct and operate for a source where inadequate information exists as to the likely performance of the planned controls for a pollutant of interest. In such cases, additional conditions will be imposed with respect to (i) demonstration/performance testing, (ii) test runs to set operational parameters, (iii) test protocols, (iv) recording during testing, (v) reporting of testing and test results, (vi) duration of testing, (vii) stack emission limits and (viii) any other conditions that may be necessary to ensure proper operation and maintenance of the source during the temporary operation of the source.
- 3.1.5 Under the terms and conditions of such a certificate the owner/operator may proceed to operate, on a temporary basis and for a limited period of time with a maximum of six months, in order to:
- carry out stack testing in accordance with Appendix 9;
 - ascertain operational/critical parameters for inclusion as conditions of a revised certificate to construct and operate;
 - test monitoring equipment; and/or
 - gather other operational information found necessary on a case-by-case basis.
- 3.1.6 All certificates of approval to construct and operate will require that the construction be initiated within twelve (12) months of the issuance of the certificate and completed within 24 months, or for large projects, on a schedule set as a condition of approval. Where only part of the approved works are actually constructed within the stated time limits, it may be necessary to re-evaluate the source immediately before operation of the partially completed facility is allowed. This will be required if there is reason to believe that emissions might be different from those originally expected.
- 3.1.7 The information required under the conditions of the approval to construct and operate may be used in the following ways:

- to verify compliance: stack testing will show whether or not a facility is in compliance with the stack emission standard(s) set out in the CAP regulation and/or proposed in the applicant's technology review and specified as conditions in the certificate to construct and operate;
- to establish operational parameters and procedures, monitoring requirements, critical emission parameters and other pertinent findings to be set out as conditions in a revised approval to construct and operate.

3.2 Certificate of Approval (Construct)

3.2.1 A certificate of approval to operate shall be obtained by any person engaged in normal, productive operation of a facility, process, piece of equipment or thing, where the following conditions apply:

- no certificate of approval to construct was required to be obtained under earlier versions of the Environmental Protection Act (i.e., where the source predates the requirement for approval to construct); and
- the source requires no physical alteration or modification in order to meet the requirements of the amended Act and the revised Regulation as proposed for the Clean Air Program.

3.2.2 Certificates of approval to operate will address the normal, productive operation of a facility, process, piece of equipment or thing, as well as reasonably expectable operating periods such as startup, shutdown and designed bypasses. This certificate will include, but is not limited to, the following conditions:

- operational parameters considered necessary to ensure that the source/facility does not emit contaminants in excess of the stack emission limits set out in the Regulation;
- operation with due care at all times to prevent upsets or conditions which may lead to emissions greater than the emission limits;
- preventive maintenance procedures;
- process and emission control alarms and interlocks;
- reliability of air pollution control equipment and process controls proposed for this source;
- recording and reporting procedures to ensure that the preceding conditions are met and for auditing and inspection by the District Officer;

- frequency and protocol for future emission testing;
 - startup, shutdown and emergency shutdown procedures and schedule to minimize emissions (see Appendix 7-4);
 - other special conditions on a case-by-case basis; and
 - certificate expiry date.
- 3.2.3 The certificate to operate will be time-limited in accordance with the expiry date set out as a condition on the certificate. All certificates to operate will have to be renewed every 10 years or at more frequent intervals as deemed necessary by the Approvals Director. Alteration of the approved sources will require resubmission of an application for approval first as a modified source.

3.3 Generic Certificates of Approval

Generic approvals will be developed to expedite the approvals process for repetitive-type applications, which cover similar industrial or commercial operations with similarities in design, layout or other relevant criteria (e.g., gasoline or propane dispensing facilities, dry-cleaning establishments, small boilers). In this category, there are numerous installations in which the control technology, modes of operation, emissions evolved and surrounding land use are similar, and therefore an engineering review of each type is deemed sufficient for the purpose of granting a certificate for the entire group, provided that the proposed source meets the criteria assumed for deeming the generic approval acceptable. For additional information, refer to Appendix 4-2.

4. APPLICATIONS FOR CERTIFICATES OF APPROVAL

4.1 Basic Information Requirements

All applications will require the same basic information processing, regardless of whether they are for construction and operation, or for operation only. The following outlines the basic requirements:

- 4.1.1 The owner/operator may apply for this certificate by filling out the appropriate application forms and providing all information required to address matters outlined in 3. previously. Insufficient information may result in refusal of approval, or delayed processing of the application.
- 4.1.2 An application for a certificate of approval to construct and operate will first encompass basic information related to a source or sources of

emissions namely: owner, operator or designate, location, process description, heat and material balance, emission controls, production data, operating information, relevant drawings and plot plan, surrounding land use, stack and source parameters, raw materials, contaminants emitted, emission rates and limits, noise parameters, cost of process and control equipment, construction schedule and commissioning schedule.

4.1.3 The owner/operator must include the documentation supporting source emission limits with the application for an approval, for emissions of all emitted contaminants.

4.1.4 The application for a certificate of approval to construct and operate will also encompass detailed information with respect to:

- operation and operating parameters determined during performance testing of similar units or the subject unit(s) in the past, etc.,
- maintenance,
- monitoring, and
- emergency procedures.

4.2 Application for Renewal of a Certificate of Approval

4.2.1 The application for a renewal of a certificate of approval shall include all information in 3 above, and in addition data on operation and maintenance of the source during the previous operating period as well as the documentation supporting the source emission limits for the contaminants emitted by the source.

4.2.2 Recommissioning of a source which has been shut down for more than 12 months will require that a new approval be obtained.

4.3 Completed Application

4.3.1 A completed application provides all information in sufficient detail that an engineering and scientific assessment can be carried out for the purpose of predicting the environmental impact of the source under consideration. It is one in which:

- the application form is completely filled out by placing pertinent information in the spaces provided on the form and striking-out all other spaces that are not applicable,
- all supporting information is attached as detailed below, and

- duplicate copies of the form and supporting information are provided.
- 4.3.2 Incomplete Forms: The forms represent the minimum amount of information necessary for a technical assessment; each space on a form should be filled in or struck-off. Incomplete forms or forms with insufficient attached information, e.g., engineering reports, technology review reports, will be returned to the applicant from the approvals branch or from the district office.

5. REQUIRED INFORMATION

5.1 Drawings and Related Information

Sufficient information by way of drawings and flow diagrams shall be provided with an application to clearly represent the equipment, process or facility. It is important for an engineering review that the drawings be up to date, to scale and show all buildings, process equipment, material handling facilities, points of emission (location and height) and the property limits.

The following materials will be required as supporting information, where they are relevant to the source type:

- process flow diagrams for raw materials e.g. solids, liquids and gases from input to the final product stage (most sources will require this),
- flow diagrams of pollutant generation to final emission (all sources require this),
- traffic flow diagrams (where vehicles are routinely used on site, other than by employees travelling to and from the facility),
- heat and material balance flow diagrams (generally for combustion systems, but also many chemical processes),
- site or plot plan to scale showing all buildings, process equipment, property line locations, emission sources [e.g. stacks, vents, roof exhaust fans, storage piles, material handling facilities, storage tanks, roadways] (all sources require this),
- building drawings [e.g., floor plans, roof plan, building elevations] showing critical receptors on-property [e.g., fresh air intakes, openable doors or windows] (where the source is in, on or near a building),
- plot plan showing relation of emission points to off-property structures in immediate neighbourhood (all sources require this; may be combined with site plan noted above and/or roof plan),

- manufacturers' shop drawings of process and environmental control equipment (where equipment is involved and available drawings show relevant design details),
- photographs of existing and/or similar facilities, equipment, etc., aerial photographs (to augment or serve in lieu of plans or drawings),
- documentation of the background concentrations of pollutants emitted by the source in the area of the source (all sources require this), and
- input data required for dispersion modelling and results of dispersion calculations carried out by or for the applicant (all sources require this).

5.2 Emission Limit Documentation

Documentation supporting the acceptability to the Ministry of the emission limits used in designing sources shall be included with all applications to construct and operate for a new source or a modified existing source as well as with all applications for an approval to operate. The detailed review procedure is outlined in the "Guideline for Determination of Emission Limits" (Appendix 7-2) and the "Emission Limit-Setting Process" (Appendix 7-3).

5.3 Estimated Emission Rates

5.3.1 Contaminant emission rates must be stated in all applications for new or renewal certificates to construct and operate for renewal of certificates of approval to operate. Emission rates may be estimated by any valid method, subject to this Ministry's review and acceptance. Emission rates estimated in the following ways will usually be reviewed favourably:

- stack testing results for sources similar to that under review,
- previous stack testing of the source when an existing source is under review,
- heat and material balance methods,
- other engineering and scientific calculations (e.g., evaporation rates), and/or
- manufacturers' performance guarantees on air pollution control equipment.

5.3.2 Since CAP requires an air shed modelling approach for all sources in an area, reasonably accurate emission rates are required in addition to maximum possible emission rates.

5.3.3 Modelling methods are described in Appendix 8, Air Quality and Modelling. The applicant shall model the sources applied for in the application along with all existing sources on the property as well as all known sources outside the property, if those sources emit the same contaminants as the source(s) proposed. Techniques for determining how far to go in examining off-property sources and accessing information on such sources is given in Appendix 8. The modelling results are to be submitted as supporting information with the application.

6. PRELIMINARY REVIEW OF APPLICATIONS

When an application and its supporting documentation are prepared, the package proceeds for submission to the Ministry. The following sections, along with the flow chart on pages 10, 11, 12 to describe the mechanism of the approvals review process. It should be noted that the applicant is expected to have completed the Emission Limit Setting Process (Appendix 7-3) in preparing the application.

6.1 Routing of applications

The application in duplicate shall be forwarded to the Ministry's Regional or District office having jurisdiction in environmental matters for the geographic area in which the facility will be constructed and operated; in the case of mobile equipment, it shall be the MOE office for the area in which the owner's head office is located.

6.2 District Office

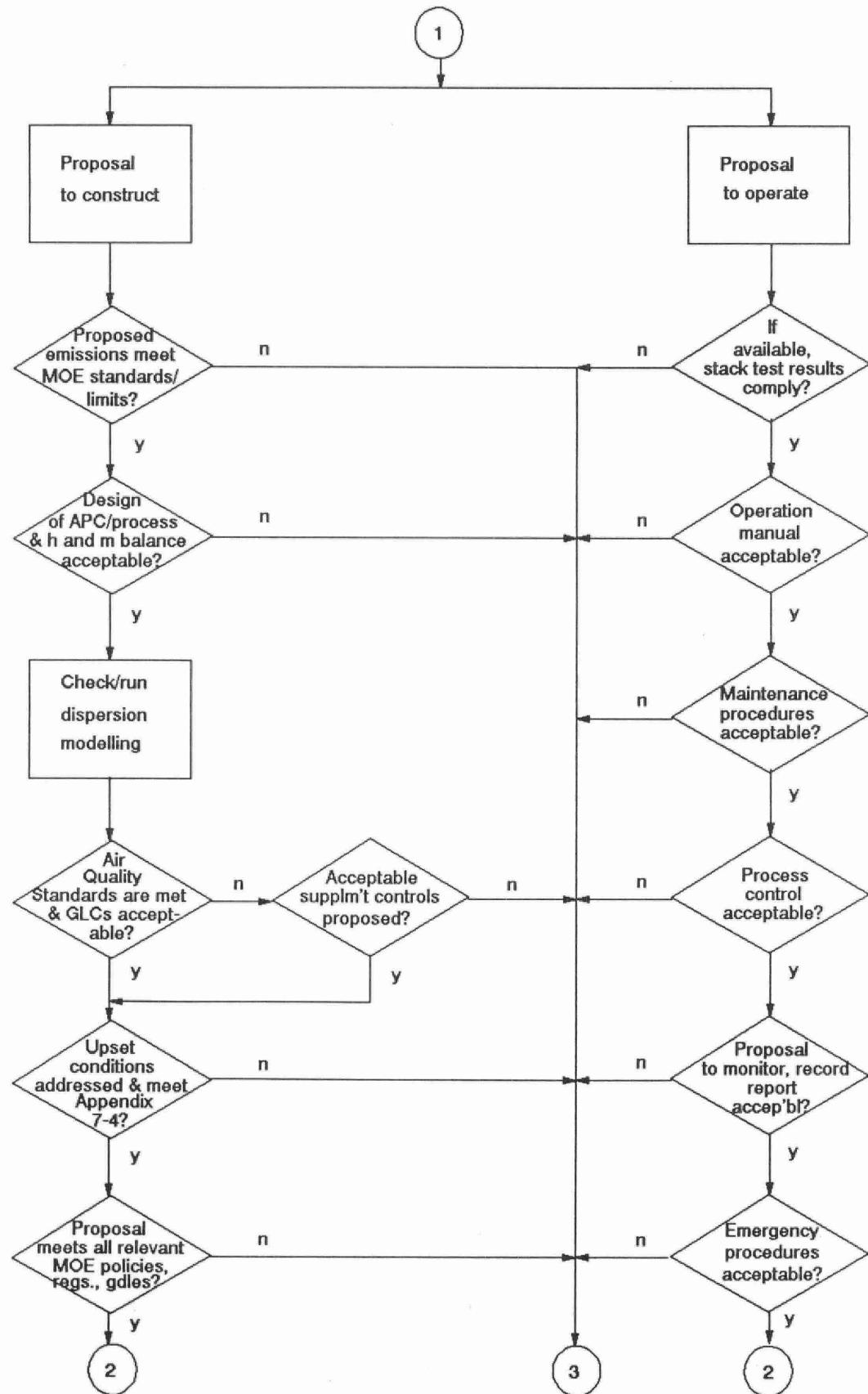
The application is reviewed by the District Office staff, and if found to be incomplete will be returned to the applicant. If the application is considered to be complete, the District Officer will have two possible courses of action. If the source is capable of treatment as a Generic Approval, he may direct it to staff of his District or Regional Office for processing. If it is not capable of treatment as a Generic Approval, he will forward the application to the Approvals Branch with his comments and recommendations, while retaining the duplicates of the application and other submitted material for the District Office records.

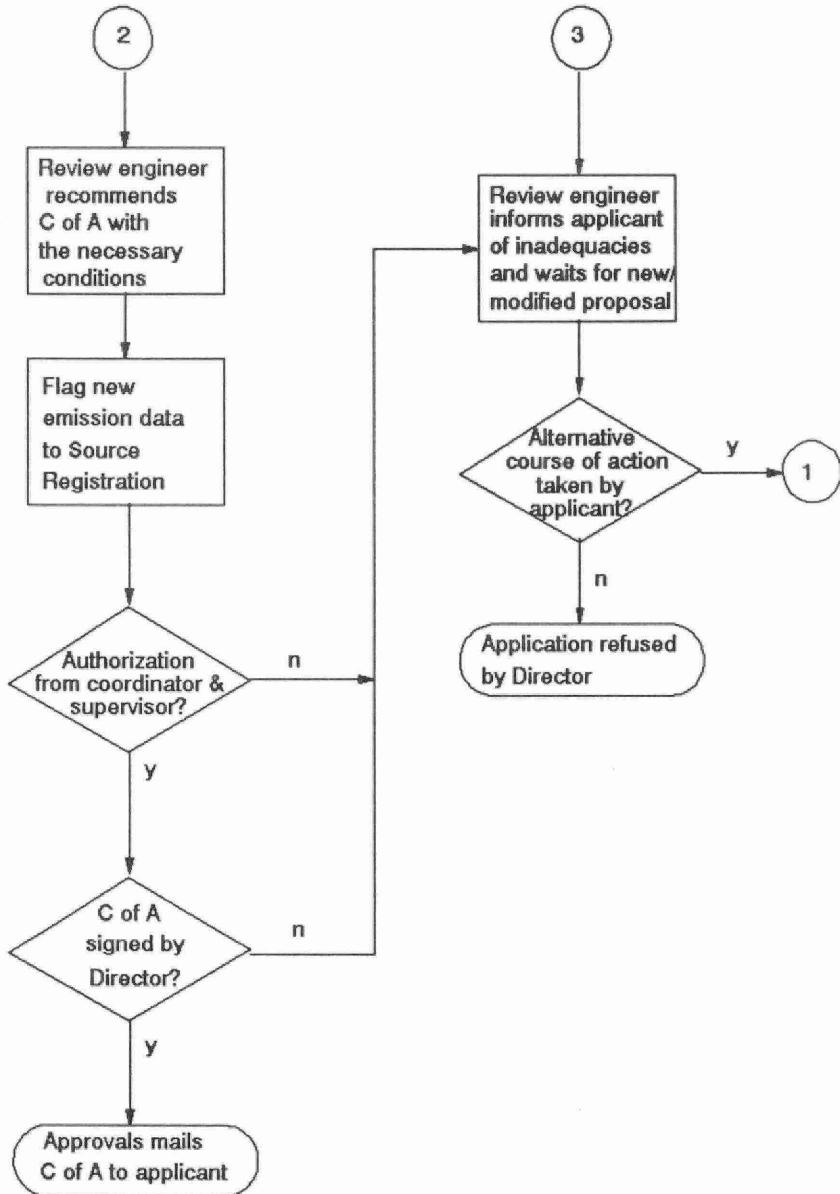
6.3 Approvals Branch

Upon arrival at the Approvals Branch, an application will be logged in by number prior to it being assigned to a review engineer. An incomplete application will be refused approval and returned to the applicant. If the application is complete, an acknowledgement notice will be forwarded to the applicant.

APPROVALS PROCESS - CAP







7. REVIEW OF APPLICATIONS

7.1 The review engineer's responsibility is to carry out an engineering assessment of an application and recommend approval, approval with conditions or a refusal to the Director, Approvals Branch. The engineering review will determine if an application meets the following criteria.

7.1.1 Currency of Emission Limits

Prior to applying for approval, the proponent must ensure that the design will meet the current emission limits for such sources. The proponent is required to contact the Air Resources Branch of the Ministry to determine whether or not a limit exists and is current at the time of the application; if not, the applicant will be responsible for preparing a Technology Review following the guidance given in the Guidelines for Determination of Emission Limits (Appendix 7-2). Documentation showing that the Ministry has confirmed these values as current will be necessary.

7.1.2 Estimated Emission Rates

The estimated emission rates are audited by carrying out engineering calculations, reviewing stack testing results, if available, or heat and material balances prior to modelling. This part of the review determines if the control or process technology is adequate to meet the stack emission limits for the type of process. Stack testing may be required as a condition of the permit as proof of the emission levels claimed.

7.1.3 Air Emission Modelling

The results of modelling must show that air quality standards in the vicinity of the proposed source are met at all times, unless supplementary controls are proposed, meeting the requirements set out in Appendix 8-5.

7.1.4 Treatment of upsets, startups, shutdowns and bypasses (see Appendix 7-4).

7.1.5 Compliance with All Other Ministry Regulations, Policies and Guidelines Regarding Design and Emission Limits.

7.1.6 Operation

The operational procedures (including emergency procedures), critical parameters, control systems, monitoring and recording data are reviewed to ensure a high degree of confidence in limiting emissions at all times to meet the requirements of the approval. A manual of Standard Operating Procedures, including emergency procedures, is required. Operating parameters and operator training will generally be imposed by conditions of the certificate.

7.1.7 Maintenance

Proper maintenance procedures including an adequate spare parts inventory on-site are necessary along with maintenance manuals, maintenance schedules and other appropriate records, to be kept available for Ministry audit. All of these requirements will be reviewed and may be imposed by conditions placed in the certificate.

7.1.8 Stack Testing and Performance Testing

Results of previously conducted stack tests and performance tests and/or other test runs will be reviewed in order:

- to ensure that the stack emission limits required by conditions on the certificate of approval, or resulting from a new Technology Review, are met, and
- to establish clearly defined operating parameters.

8. REVIEW ENGINEER'S RECOMMENDATION

- 8.1 Subject to the recommendation of the Review Engineer upon completion of the evaluation of the application, the Director may issue or refuse to issue a certificate.
- 8.2 *Issue of Approval:* Most certificates of approval will include conditions imposed by the Approvals Director. These conditions may be appealed by the owner/operator of the proposed source.
- 8.3 *Refusal of Permit:* The Director may refuse to issue an approval by sending a Notice with reasons. The refusal may be appealed by the owner/operator of the proposed source.

9. APPEAL PROCEDURES

- 9.1 Both the imposition of conditions and a refusal by the Director are appealable to the Environmental Appeal Board under Section 122a of the Act. In each case, a notice setting out the reasons is sent by registered mail to the applicant. The applicant may appeal the Approvals Director's decision by requesting a hearing before the Board within 15 days after receipt of the notice. The request must identify the terms and conditions with respect to which the appeal is made.

- 9.2 The Board will call a hearing in which other interested parties may also appear. Upon presentation of arguments and evidence, the Board may confirm, alter or revoke the Director's decision.
- 9.3 Any party to a hearing may appeal the Board's decision on questions of law to Divisional Court, further to the Ontario Court of Appeal and finally to the Supreme Court of Canada, or to the Lieutenant Governor in Council (Cabinet) in all other matters.

10. INSPECTIONS BY MINISTRY STAFF

- 10.1 Conditions on the certificate to construct and operate will require that the owner/operator notify the appropriate District Office when the approved source has been constructed. Staff of the District Office may then inspect the source to ensure that it has been constructed in accordance with the certificate of approval as well as witness all or part of any demonstration/performance testing or any other test runs required by conditions in the certificate of approval.
- 10.2 Conditions on the certificate to construct and/or operate will require that the owner/operator notify the appropriate District Office when the approved source commences normal operations.
- 10.3 Conditions on the certificate to operate will require that the owner/operator notify the appropriate District Office when a source is decommissioned or otherwise taken out of service for an extended period of time.

APPENDIX 4-2

CLASS ENVIRONMENTAL APPROVALS



APPENDIX 4-2

CLASS ENVIRONMENTAL APPROVALS

In its proposals concerning approval of facilities the Ministry has outlined levels of emission below which there is no regulatory concern - identified as the Small Source Exemption Limit (SSEL). Under these requirements, operators of sources which qualify, will only have to register their emissions and show compliance with air quality standards. Therefore, effectively they will be exempt from control requirements.

Many source types exist in the province which will not qualify for the SSEL exemption or exemptions under other provisions, but for which at the same time the full evaluation process is not justified in terms of expenditure of effort by the proponent and the Ministry in relation to marginal benefits. It should be noted that many such sources are now being operated without certificates of approval. For these sources Class Environmental Approvals will be granted. The proposed class approach is similar to that used by the Ministry for environmental assessments. Essential differences between the proposal and the provisions for dealing with Class Environmental Assessments include the absence of provisions under the proposed Class Approval approach for public hearings, and the placing of onus on the Ministry rather than on the proponent to establish conditions for approval.

A preliminary list of sources for which Class Approval requirements may be written includes:

- retail dry cleaning operations other than totally enclosed refrigerated condenser systems which do not require venting to the atmosphere
- print shops
- restaurants
- gas filling stations
- auto body/paint shops
- office buildings heated by fossil fuels at a rate greater than 1.5m Gj/hr
- apartment buildings with more than three family units heated by fossil fuels
- shopping centers and plazas heated by fossil fuels at a rate greater than 1.5 Gj/hr

For these types of sources the Ministry will establish clear, concise class requirements. Applications for certificates of approval - air using these rules will then be subject to a defined, limited process of review. Sources treated in this manner will have to register emissions to the atmosphere, comply with general emission restrictions and meet other provisions established on a class basis such as minimum separation distances from conflicting land uses, and monitoring and operating requirements where appropriate. The

specific provisions for the operations covered under class approvals will be developed and released for public review prior to being incorporated into regulatory format. An example of the types of considerations which will be included is given below for retail dry cleaning operations.

DRY CLEANING ESTABLISHMENTS

[This example is provided to indicate the types of requirements which would be included on a class certificate. If the Ministry decides to develop the use of such certificates the actual form for dry cleaning establishments would be arrived at following discussions with the industry.]

Class exemptions for dry cleaning establishments venting to the atmosphere are intended to apply to retail facilities as opposed to large commercial operations. A limitation will therefore be imposed based on a floor area of x m². Applicants whose facilities are above this limit will be required to apply for individual certificates of approval.

Given that perchloroethylene is a possible human carcinogen for treatment under a class exemption for dry cleaning establishments venting to the atmosphere will require the inclusion of the following:

- carbon adsorbers or equivalent control systems on dryer exhausts, distillation unit vents, washer door loading vents, storage tank vents, chemical separators and floor vents with vented solvent concentrations of 100 ppm or less;
- separation distances of exhausts from other sources of perchloroethylene of x metres and from residentially zoned areas of x metres;
- a vertical stack which extends at least 2 metres above the building's roofline in the case of buildings 10m. or less for venting all emissions from perchloroethylene dry cleaning machines, with the exception of emissions from units equipped with a totally enclosed refrigerated condenser system;
- regeneration of the carbon bed at least once for every 250 kg. of garments processed.

In the case of existing facilities applying for certificates of approval to operate where an adsorber cannot be accommodated because of lack of space or insufficient steam capacity to desorb the adsorbers the requirement for such a device will be waived. When such a waiver is granted the proponent will be required to demonstrate that process emissions have been reduced to the lowest level possible.

Coin operated perchloroethylene dry cleaning facilities will be exempt from the requirement to install adsorbers

The Ministry would give consideration to the use of industry typical stack tests to provide the type of information which will be required under CAP for sources emitting Level 1 or Level 2 concern contaminants.

APPENDIX 4-3

EXPERIMENTAL FACILITIES

APPENDIX 4-3

EXPERIMENTAL FACILITIES

1. CONTROL REQUIREMENTS

The failure of the existing legislation to deal adequately with the approval of experimental facilities was identified in the Clean Air Program discussion paper; however, the document did not propose any solution other than to suggest that the Ministry should continue to deal with them on a case-by-case basis. These sources have been dealt with separately here because of this difficulty. Proponents of these facilities will not be exempt from the regulatory requirements unless they meet the small source designation limits (SSDL) or meet the exemption for small laboratories written below. The determination of emission limits will not pose too much difficulty since proponents will be required to control for worst case conditions. At the discretion of the Approvals Branch if process changes of the experimental facility are expected and known when applying for a certificate, they may be included on the certificate so that the changes may be made without having to reapply for an approval to operate before the renewal period. If this is the case, either process change dates must be included or advance notification given to the Ministry, and the control technology applied must be appropriate for controlling all phases according to the requirements of the regulation. Otherwise a new certificate is required for every process change.

There are three experimental facility categories: 1) pilot scale plants; 2) laboratories; and 3) prototypes. Laboratories which have an additive exhaust flow rate of 5 m³/sec. or less and do not emit level I contaminants will be exempt from the requirement to install controls. Those facilities which do not meet this exemption will be required to follow the regulation as written.

2. PILOT PLANTS

Pilot plants are scale models of larger plants or a portion thereof that are operated for a short period of time to generate engineering design data for the process, or trial samples of the compounds under deliberation, or both. In general, because pilot scale plants are used to determine process design many of these plants are not automated. When pilot plants are operated to determine emission control requirements the operation will be approved on condition that a report is submitted to the Approvals Branch after 3 months outlining the observed emission loads, nature of contaminants, pollution control requirements and any other relevant data.

3. LABORATORIES

Laboratories are generally much smaller operations than pilot plants. Laboratories are used for research purposes for a variety of disciplines and as such may be responsible for doing research and early development i.e., basic chemistry, for pilot plants but they are not involved in process equipment design or mass production. Laboratories are also used for

routine chemical, biological and medical testing of materials. If a facility does not meet the small laboratory exemption written above, control technology must be applied which is capable of controlling emissions of all possible contaminants released (worst case conditions).

4. PROTOTYPES

Prototypes are full scale plants which use process(es) which are new and have never been in operation before. Prototypes unlike other full scale operations lack good information on the process and reliability of control technology. And because these facilities are prone to upsets, extra care must be taken with them. The Ministry will proceed with discretion when evaluating upset and shutdowns of prototype facilities. Control technology guidance will also be provided by the Ministry to aid in the regulation of these facilities as it will for all experimental facilities.

APPENDIX 5

SMALL AND SPECIAL SOURCES

APPENDIX 5-1
SMALL SOURCE DESIGNATION LIMITS

APPENDIX 5-1

SMALL SOURCE DESIGNATION LIMITS

Exemptions from the need to apply for approvals to construct and operate are extended to truly insignificant sources under the Clean Air Program. Small Source Designation Limits (SSDLs) are given in units of kilograms per year. Where the conservatively estimated emissions of a contaminant from a source are less than the values given in the following table, controls aimed at reducing emissions of that pollutant will not generally be necessary. In sources emitting mixtures of pollutants, this will avoid the need to optimize control on trace contaminants. However, Non-Attainment Remedial Strategies or other measures targeting small sources may be implemented if necessary.

The SSDLs also serve as a baseline by which control efforts may be evaluated; for example, when optimizing controls in the process of a Technology Review for emission standard setting.

The values given in the following table are based on comparisons between four U.S. states which have published "Significance Levels" for lists of pollutants. The four states used were Kentucky, New Mexico, North Carolina and Wisconsin. In these jurisdictions, the usual result of sources exceeding these levels is to trigger the need to demonstrate that they meet an "Acceptable Ambient Level" as demonstrated by dispersion modelling. However, Wisconsin also requires the use of LAER or BACT for certain pollutants listed in one of the four tables referred to for the development of CAP SSDLs.

In addition to consulting U.S. state requirements, the lists of Interim Air Quality Standards were used as weighting factors to derive values as suggested in the 1987 discussion paper on the Clean Air Program. The basis for scaling the IAQS-derived proposals was to fix chromium, with a 24-hour IAQS of 1.5 ug/m³, at 900 grams/year. The 900 grams/year for chromium comes from Resolution 88-2-2 of the California Air Resources Board (passed February 18, 1988). The resolution calls for 95% control on chromium emissions from all hard chrome plating and chromic acid anodizing operations in the state, and further requires 99% for companies emitting more than 2 pounds/year (about 900 grams/year), and 99.8% control for those sources emitting over 10 pounds/year (about 4.5 kilograms/year). Using the 2 pounds/year requirement yields an equation relating IAQS on a 24-hour averaging time to possible SSDLs:

$$\text{SSDL(possible, kg/year)} = 0.6 \times \text{IAQS(24 hour, ug/m}^3\text{)}$$

Values derived using the above equation and the Ontario IAQS may be referred to as derived using the discussion paper method. Such values were compared to those used by the four states noted above. The most stringent value was then chosen from the Ontario and the U. S. figures. It should be noted that three of these states have these "Significance Levels" written into regulations (North Carolina is the exception, using their values as a matter of policy at present). Kentucky and North Carolina tended to have more stringent requirements. Kentucky and New Mexico had the more extensive lists of contaminants to consider.

Some adjustments have been made to the Ontario and the U.S. data. The adjustments included rounding off the figures to one significant digit and when significance levels were only available for New Mexico and Wisconsin, the smallest value was chosen and then divided by a factor of 10 because the significance levels for these states were found to be high. For some contaminants expressed as specific substances (notably iron oxide, fluoride and aluminum oxide) the following equation was applied to determine the value to be used in comparisons to yield the SSDL:

$$X = SL \times MW_{cap} / MW_{other}$$

where X = value to be compared for possible use as CAP SSDL

SL = significance level (from other jurisdiction)

MW_{cap} = molecular weight of the contaminant as expressed in this list

MW_{other} = molecular weight of the comtaminant as expressed in the other list

The list presented in the following table is that presented for the CAP source registration proposals. Not all of the pollutants listed therein were referred to in the five lists examined. As a result, a number of pollutants have asterisks to denote the lack of a SSDL at this time. In addition, several of the listed substances are chlorofluorocarbon compounds; these are noted with plus signs as potentially the subject of Bill 218.

Finally, an ultimate limit of 1000 kilograms/year was placed on all contaminants. The review of the five lists noted above would have resulted in several pollutants being classed as small sources even though they would emit tens of metric tonnes of material to the atmosphere each year. In keeping with the intent to set SSDLs as indicators of truly insignificant sources, the one metric tonne (1000 kilogram) per year cap was superimposed on the results of the comparison.

	C A S Number	CHEMICAL NAME	SMALL SOURCE DESIGNATION LIMIT
A	75-07-0	Acetaldehyde	200
	60-35-5	Acetamide	*
	64-19-7	Acetic acid	30
	67-64-1	Acetone	1000
	75-05-8	Acetonitrile	70
	98-86-2	Acetophenone	300
	53-96-3	Acetylaminofluorene, 2-	0.002
	74-86-2	Acetylene	1000
	107-02-8	Acrolein	0.3
	79-06-1	Acrylamide	0.3
	79-10-7	Acrylic acid	30
	107-13-1	Acrylonitrile	5
	309-00-2	Aldrin	3
		Alkytoluene sulphonamide, n-	70
	107-05-1	Allyl chloride	3
	7429-90-5	Aluminum	2
	1344-28-1	Aluminum oxide	2
	117-79-3	Aminoanthraquinone, 2-	0.4
	60-09-3	Aminoazobenzene, 4-	*
	92-67-1	Aminobiphenyl, 4-	0.002
	82-28-0	Amino-2-methylanthraquinone, 1-	0.04
	7664-41-7	Ammonia	18
	12125-02-9	Ammonium chloride	10
	6484-52-2	Ammonium nitrate	*
	7783-20-2	Ammonium sulphate	*
		Amyl acetate, iso-	500
	628-63-7	Amyl acetate, n-	500
	626-38-0	Amyl acetate, secondary	700
	62-53-3	Aniline	10
	90-04-0	Anisidine, ortho-	0.5
	104-94-9	Anisidine, para-	*
	134-29-2	Anisidine hydrochloride, ortho-	0.5
	120-12-7	Anthracene	*
	7440-36-0	Antimony and compounds	0.5
	7440-38-2	Arsenic and compounds	0.01
	7784-42-1	Arsine	0.2
	1332-21-4	Asbestos	8.0E-07
B	7440-39-3	Barium - total water soluble	0.5
	98-87-3	Benzal chloride	300
	55-21-0	Benzamide	*
	71-43-2	Benzene	0.8
	92-87-5	Benzidine	0.002
	98-07-7	Benzoic trichloride	5
	95-16-9	Benzothiazole	40
	98-88-4	Benzoyl chloride	5
	94-36-0	Benzoyl peroxide	5
	50-32-8	Benzo[a]pyrene	0.0007
	205-99-2	Benzo[b]fluoranthene	*
	205-82-3	Benzo[j]fluoranthene	*
	205-08-9	Benzo[k]fluoranthene	*

C A S Number	CHEMICAL NAME	SMALL SOURCE DESIGNATION LIMIT
100-44-7	Benzyl chloride	5
56-55-3	Benz[a]anthracene	*
7440-41-7	Beryllium and compounds	0.002
92-52-4	Biphenyl	2
111-44-4	Bis(2-chloroethyl) ether	30
108-60-1	Bis(2-chloro-1-methylethyl) ether	*
103-23-1	Bis(2-ethylhexyl) adipate	*
542-88-1	Bis(chloromethyl) ether	0.005
	Borax	20
10043-35-3	Boric acid	20
7440-42-8	Boron	70
10294-33-4	Boron tribromide	7
10294-34-5	Boron trichloride	20
7637-07-2	Boron trifluoride	1
314-40-9	Bromacil	6
7726-95-6	Bromine	0.7
353-59-3	Bromochlorodifluoromethane	+
75-25-2	Bromoform	5
25497-30-7	Bromotetrafluoroethane	+
75-63-8	Bromotrifluoromethane	+
106-99-0	Butadiene, 1,3-	5
78-83-1	Butanol, iso-	200
71-36-3	Butanol, n-	100
78-92-2	Butanol, secondary	300
75-65-0	Butanol, tertiary	300
123-86-4	Butyl acetate, n-	200
141-32-2	Butyl acrylate	60
85-68-7	Butyl benzyl phthalate	*
123-95-5	Butyl stearate	70
106-88-7	Butylene oxide, 1,2-	*
123-72-8	Butyraldehyde	*
C 7440-43-9	Cadmium and compounds	0.05
75-20-7	Calcium carbide	6
156-62-7	Calcium cyanamide	0.5
592-01-8	Calcium cyanide	70
1305-62-0	Calcium hydroxide	5
1305-78-8	Calcium oxide	2
130-06-2	Captan	5
63-25-2	Carbaryl	5
1333-86-4	Carbon black	4
75-15-0	Carbon disulphide	30
630-08-0	Carbon monoxide	*
56-23-5	Carbon tetrachloride	30
463-58-1	Carbonyl sulphide	*
120-80-9	Catechol	20
133-90-4	Chloramben	70
57-74-9	Chlordane	0.5
7782-50-5	Chlorine	3
10049-04-4	Chlorine dioxide	0.3
79-11-8	Chloroacetic acid	*

C A S Number	CHEMICAL NAME	SMALL SOURCE DESIGNATION LIMIT
532-27-4	Chloroacetophenone	0.3
108-90-7	Chlorobenzene	400
510-15-6	Chlorobenzilate	*
75-45-6	Chlorodifluoromethane	+
75-00-3	Chloroethane	*
67-66-3	Chloroform	50
107-30-2	Chloromethyl methyl ether	0.002
76-15-5	Chloropentafluoroethane	+
25167-80-0	Chlorophenol	0.002
	Chlorophenoxy herbicides	*
126-99-8	Chloroprene	40
1897-45-6	Chlorothalonil	*
7440-47-3	Chromium - di-, tri- and hexavalent forms	0.003
77-92-9	Citric acid	70
8007-45-2	Coal tar pitch volatiles - soluble fraction	0.2
7740-48-4	Cobalt	0.06
7440-50-8	Copper	0.2
120-71-8	Cresidine, para-	0.002
1319-77-3	Cresol (mixed isomers)	20
108-39-4	Cresol, meta-	*
95-48-7	Cresol, ortho-	*
106-44-5	Cresol, para-	*
80-15-9	Cumene hydroperoxide	*
135-20-6	Cupferron	0.002
506-77-4	Cyanogen chloride	0.4
	Cyclo sol 63	1000
110-82-7	Cyclohexane	1000
4680-78-8	C.I. Acid Green 3*	*
569-64-2	C.I. Basic Green 4*	*
989-38-8	C.I. Basic Red 1*	*
16071-86-6	C.I. Brown 95*	0.2
1937-37-7	C.I. Direct Black 38*	0.2
2602-46-2	C.I. Direct Blue 6*	0.2
2832-40-8	C.I. Disperse Yellow 3*	*
81-88-9	C.I. Food Red 15*	*
3761-53-3	C.I. Food Red 5*	*
3118-97-6	C.I. Solvent Orange 7*	*
842-07-9	C.I. Solvent Yellow 14*	*
492-80-8	C.I. Solvent Yellow 34*	*
97-56-3	C.I. Solvent Yellow 3*	*
128-66-5	C.I. Vat Yellow 4*	*
D 127-20-8	Dalapon sodium salt	30
50-29-3	DDT	*
17702-41-9	Decaborane	0.3
1163-19-5	Decabromodiphenyl oxide	*
124-18-5	Decane, n-	1000
872-05-9	Decene, 1-	1000
1395-21-7	Detergent enzyme (Subtilisin)	0.02
123-42-2	Diacetone alcohol	200

C A S Number	CHEMICAL NAME	SMALL SOURCE DESIGNATION LIMIT
615-05-4	Diaminoanisole, 2,4-	*
39156-41-7	Diaminoanisole sulphate, 2,4-	0.002
101-80-4	Diaminodiphenyl ether, 4,4'-	0.002
25376-45-8	Diaminotoluene (mixed isomers)	100
95-80-7	Diaminotoluene, 2,4-s	0.002
333-41-5	Diazinon	0.1
334-88-3	Diazomethane	0.4
132-64-9	Dibenzofuran	*
192-65-0	Dibenzo[a,e]pyrene	*
189-64-0	Dibenzo[a,h]pyrene	*
189-55-9	Dibenzo[a,i]pyrene	*
191-30-0	Dibenzo[a,l]pyrene	*
226-36-8	Dibenzo[a,h]acridine	*
53-70-3	Dibenzo[a,h]anthracene	*
224-42-0	Dibenzo[a,j]acridine	*
19287-45-7	Diborane	0.1
96-12-8	Dibromo-3-chloropropane, 1,2-	0.002
111-92-2	Dibutyl amine	700
84-74-2	Dibutyl phthalate	5
77-58-7	Dibutytin dilaurate	20
131-15-7	Dicapryl phthalate	300
25321-22-6	Dichlorobenzene (mixed isomers)	1000
95-50-1	Dichlorobenzene, 1,2- (ortho)	200
541-73-1	Dichlorobenzene, 1,3- (meta)	*
106-46-7	Dichlorobenzene, 1,4- (para)	500
91-94-1	Dichlorobenzidine, 3,3-	0.002
75-27-4	Dichlorobromomethane	*
107-06-2	Dichloroethane, 1,2-	10
540-59-0	Dichloroethylene, 1,2-	800
120-83-2	Dichlorophenol, 2,4-	*
94-75-7	Dichlorophenoxyethanoic acid, 2,4- (2,4 D)	10
542-75-6	Dichloropropylene	5
1320-37-2	Dichloro-1,1,2,2,-tetrafluoro ethane, 1,1-	+
76-14-2	Dichloro-1,1,2,2,-tetrafluoro ethane, 1,2-	+
62-73-7	Dichlorvos	1
115-32-2	Dicofol	*
1464-53-5	Diepoxybutane	0.002
111-42-2	Diethanolamine	20
109-89-7	Diethyl amine	30
84-66-2	Diethyl phthalate (DEP)	70
64-67-5	Diethyl sulphate	0.002
112-34-5	Diethylene glycol monobutyl ether	40
124-17-4	Diethylene glycol monobutyl ether acetate	50
111-90-0	Diethylene glycol monoethyl ether	200
112-12-5	Diethylene glycol monoethyl ether acetate	1000
75-71-8	Difluorodichloromethane	+
84-75-3	Dihexyl phthalate (DHP)	30
108-83-8	Diisobutyl ketone	90
119-90-4	Dimethoxybenzidine, 3,3'-	0.002
124-40-3	Dimethyl amine	20

C A S Number	CHEMICAL NAME	SMALL SOURCE DESIGNATION LIMIT
624-92-0	Dimethyl disulphide	10
115-10-6	Dimethyl ether	1000
57-14-7	Dimethyl hydrazine, 1,1-	1
756-79-6	Dimethyl methylphosphonate	500
105-67-9	Dimethyl phenol, 2,4-	*
131-11-3	Dimethyl phthalate (DMP)	5
77-78-1	Dimethyl sulphate	0.5
75-18-3	Dimethyl sulphide	*
127-19-5	Dimethylacetamide, n,n-	40
60-11-7	Dimethylaminoazobenzene, 4-	0.002
108-69-0	Dimethylaniline, 3,5-	*
121-69-7	Dimethylaniline, N,N-	30
119-93-7	Dimethylbenzidine, 3,3'-	0.002
79-44-7	Dimethylcarbamyl chloride	0.002
109-55-7	Dimethyl-1,3-diamino propane, n,n-	10
534-52-1	Dinitro-o-cresol, 4,6-	0.2
51-28-5	Dinitrophenol, 2,4-	*
121-14-2	Dinitrotoluene, 2,4-	2
606-20-2	Dinitrotoluene, 2,6-	*
117-84-0	Dioctyl phthalate, n-	30
123-91-1	Dioxane, 1,4-	90
646-06-0	Dioxolane	6
22-66-7	Diphenolhydrazine, 1,2-	0.1
122-39-4	Diphenylamine	10
85-00-7	Diquat dibromide - respirable (<10 um aero. diam.)	0.02
85-00-7	Diquat dibromide - total	0.1
117-81-7	Di-(2-ethylhexyl) phthalate (DEHP)	5
1886-81-3	Dodecyl benzene sulphonic acid	70
24391-00-3	Dodine	6
548-73-2	Droperidol	0.6
E 106-89-8	Epichlorohydrin	10
64-17-5	Ethanol	1000
141-78-6	Ethyl acetate	1000
140-88-5	Ethyl acrylate	1
100-41-4	Ethyl benzene	400
541-41-3	Ethyl chloroformate	*
60-29-7	Ethyl ether	1000
763-69-9	Ethyl-3-ethoxy propionate	30
104-76-7	Ethyl hexanol, 2-	200
84-51-5	Ethylanthraquinone, 2-	6
74-85-1	Ethylene	20
106-93-4	Ethylene dibromide	0.002
10-76-2	Ethylene dichloride	40
107-21-1	Ethylene glycol	1000
111-76-2	Ethylene glycol butyl ether	70
1121-71-2	Ethylene glycol butyl ether acetate	100
628-96-6	Ethylene glycol dinitrate	0.3
110-80-5	Ethylene glycol ethyl ether	200
111-15-9	Ethylene glycol ethyl ether acetate	30
112-25-4	Ethylene glycol monohexyl ether	40

C A S Number	CHEMICAL NAME	SMALL SOURCE DESIGNATION LIMIT
75-21-8	Ethylene oxide	1
96-45-7	Ethylene thiourea	0.002
60-00-4	Ethylenediaminetetraacetic acid	70
151-56-4	Ethyleneimine	30
F 990-73-8	Fentanyl citrate	0.01
1309-37-1	Ferric oxide	10
2164-17-2	Fluometon	*
7664-39-3	Fluorides (as HF) - gaseous	0.5
7664-39-3	Fluorides (as HF) - total	1
	Fluorinert 3M-FC-70	70
50-00-0	Formaldehyde	2
64-18-6	Formic acid	9
98-01-1	Furfural	8
98-00-0	Furfuryl alcohol	40
G 8006-61-9	Gasoline	1000
111-30-8	Glutaraldehyde	0.4
H 52-86-8	Haloperidol	0.06
76-44-8	Heptachlor	0.5
38998-75-3	Heptachloro dibenzofuran (mixed isomers)	*
	Heptachloro dibenzofuran, 1,2,3,4,6,7,8-	*
	Heptachloro dibenzofuran, 1,2,3,4,7,8,9-	*
37871-00-4	Heptachloro dibenzo-p-dioxin (mixed isomers)	*
	Heptachloro dibenzo-p-dioxin, 1,2,3,4,6,7,8-	*
118-74-1	Hexachlorobenzene	10
87-68-3	Hexachloro-1,3-butadiene	0.2
77-47-4	Hexachlorocyclopentadiene	0.1
55684-94-1	Hexachloro dibenzofuran (mixed isomers)	*
	Hexachloro dibenzofuran, 1,2,3,4,7,8-	*
	Hexachloro dibenzofuran, 1,2,3,6,7,8-	*
	Hexachloro dibenzofuran, 1,2,3,7,8,9-	*
	Hexachloro dibenzofuran, 2,3,4,6,7,8-	*
34465-46-8	Hexachloro dibenzo-p-dioxin (mixed isomers)	*
	Hexachloro dibenzo-p-dioxin, 1,2,3,4,7,8-	*
	Hexachloro dibenzo-p-dioxin, 1,2,3,6,7,8-	*
	Hexachloro dibenzo-p-dioxin, 1,2,3,7,8,9-	*
67-72-1	Hexachloroethane	100
1335-87-1	Hexachloronaphthalene	0.2
999-97-3	Hexamethyl disilazane	1
822-06-0	Hexamethylene diisocyanate monomer	0.3
4035-89-6	Hexamethylene diisocyanate trimer	0.6
680-31-9	Hexamethylphosphoramide	0.002
110-54-3	Hexane	200
107-41-5	Hexylene glycol	90
302-01-2	Hydrazine	0.1
10034-93-2	Hydrazine sulphate	0.1
10035-10-6	Hydrogen bromide	10
7647-01-0	Hydrogen chloride	5
74-90-8	Hydrogen cyanide	7
7664-39-3	Hydrogen fluoride	0.5
7722-84-1	Hydrogen peroxide	2

C A S Number	CHEMICAL NAME	SMALL SOURCE DESIGNATION LIMIT
7783-06-4	Hydrogen sulphide	8
123-31-9	Hydroquinone	2
I 193-39-5	Indeno[1,2,3,cd]pyrene	*
15438-31-0	Iron - metallic	2
110-19-0	Isobutyl acetate	300
97-85-8	Isobutyl isobutyrate	*
78-84-2	Isobutyraldehyde	*
108-21-4	Isopropyl acetate	300
98-82-8	Isopropyl benzene	30
80-05-7	Isopropylidenediphenol, 4,4'-	*
L 7439-92-1	Lead and compounds	3
58-89-9	Lindane	0.5
	Lithium - other than hydrides	10
7580-67-8	Lithium hydrides	0.02
M 1309-48-4	Magnesium oxide	10
121-75-5	Malathion	10
108-31-6	Maleic anhydride	1
12427-38-2	Maneb	*
7439-96-5	Manganese compounds (as Mn) - including permanganates	1
12108-13-3	Manganese methylcyclopentadienyl tricarbonyl	0.1
108-78-1	Melamine	*
74-93-1	Mercaptans (as Methyl mercaptan) - total	1
120-78-5	Mercapto benzo thiazo disulphide	70
7439-97-6	Mercury	1
7439-97-6	Mercury - alkyl compounds (as Hg)	0.01
108-62-3	Metaldehyde	70
79-41-4	Methacrylic acid	70
101-68-8	Methane diphenyl diisocyanate	0.1
67-56-1	Methanol	300
72-43-5	Methoxychlor	10
109-86-4	Methoxyethanol, 2-	20
96-33-3	Methyl acrylate	1
74-83-9	Methyl bromide	20
74-87-3	Methyl chloride	100
78-93-3	Methyl ethyl ketone	600
1338-23-4	Methyl ethyl ketone peroxide	1
60-34-4	Methyl hydrazine	0.2
74-88-4	Methyl iodide	10
108-10-1	Methyl isobutyl ketone	200
624-83-9	Methyl isocyanate	0.05
2987-53-3	Methyl mercapto aniline	*
80-62-6	Methyl methacrylate	400
119-36-8	Methyl salicylate	60
98-83-9	Methyl styrene, alpha-	200
1634-04-4	Methyl tert-butyl ether	*
110-12-3	Methyl-2-hexanone, 5-	90
872-50-4	Methyl-2-pyrrolidone, n-	1000
109-87-5	Methylal	1000
3697-24-3	Methylchrysene, 5-	*
12108-13-3	Methylcyclopentadienyl manganese tricarbonyl (MMT)	0.2

C A S Number	CHEMICAL NAME	SMALL SOURCE DESIGNATION LIMIT
101-14-4	Methylene bis-2-chloroaniline, 4,4'-	0.2
101-61-1	Methylene bis(N,N-dimethyl) benzenamine, 4,4'-	*
74-95-3	Methylene bromide	*
75-09-2	Methylene chloride	400
101-77-9	Methylene dianiline, 4,4'-	0.8
110-43-0	Methyl-n-amyl ketone	20
90-94-8	Michler's ketone	0.002
22832-87-7	Miconazole nitrate	3
	Milk powder	10
	Mineral fibres	*
64475-85-0	Mineral spirits	*
7439-98-7	Molybdenum	5
1313-27-5	Molybdenum trioxide	*
74-89-5	Monomethyl amine	10
505-60-2	Mustard gas	*
N	91-20-3 Naphthalene	8
	90-15-3 Naphthol, alpha-	60
	134-32-7 Naphthylamine, alpha-	*
	91-59-8 Naphthylamine, beta-	0.002
	7440-02-0 Nickel	0.1
13463-39-3	Nickel carbonyl	0.3
7697-37-2	Nitric acid	5
18662-53-8	Nitrilotriacetic acid	0.002
99-59-2	Nitro-o-anisidine	0.002
98-95-3	Nitrobenzene	5
92-93-3	Nitrobiphenol, 4-	50
1836-75-5	Nitrofen	0.002
51-75-2	Nitrogen mustard	0.002
10102-44-0	Nitrogen oxides (as Nitrogen dioxide)	100
55-63-0	Nitroglycerin	0.5
88-75-5	Nitrophenol, 2-	*
100-02-7	Nitrophenol, 4-	*
79-46-9	Nitropropane, 2-	60
55-18-5	Nitrosodiethylamine, n-	0.002
62-75-9	Nitrosodimethylamine, n-	0.002
924-16-3	Nitrosodi-n-butylamine, n-	0.002
86-30-6	Nitrosodiphenolamine, n-	*
156-10-5	Nitrosodiphenolamine, p-	*
759-73-9	Nitroso-N-ethylurea, n-	0.002
684-93-5	Nitroso-N-methylurea, n-	0.002
4549-40-0	Nitrosomethylvinylamine, n-	0.002
59-89-2	Nitrosomorpholine, n-	70
16543-55-8	Nitrosornornicotine, n-	0.5
100-75-4	Nitrosopiperidine, n-	0.002
621-64-7	Nitroso-n-propylamine, n-	0.002
10024-97-2	Nitrous oxide	1000
O	39001-02-0 Octachloro dibenzofuran	*
	3268-87-9 Octachloro dibenzo-p-dioxin	*
	2234-13-1 Octachloronaphthalene	0.1
	111-65-9 Octane	1000

C A S Number	CHEMICAL NAME	SMALL SOURCE DESIGNATION LIMIT
25377-83-7	Octene, 1-	1000
112-80-1	Oleic acid	1
20816-12-0	Osmium tetroxide	0.002
144-62-7	Oxalic acid	1
10028-15-6	Ozone	40
P 7657-10-1	Palladium - water soluble compounds	6
1910-42-5	Paraquat dichloride - respirable (<10 um aero. diam.)	0.002
1910-42-5	Paraquat dichloride - total	0.009
56-38-2	Parathion	0.1
	Particulate matter - inhalable (< 10 um aero. diam.)	*
	Particulate matter - suspended (< 44 um aero. diam.)	70
1406-05-9	Penicillin	0.06
19624-22-7	Pentaborane	0.01
608-93-5	Pentachlorobenzene	*
30402-15-4	Pentachloro dibenzofuran (mixed isomers)	*
	Pentachloro dibenzofuran, 1,2,3,7,8-	*
	Pentachloro dibenzofuran, 2,3,4,7,8-	*
36088-22-9	Pentachloro dibenzo-p-dioxin (mixed isomers)	*
	Pentachloro dibenzo-p-dioxin, 1,2,3,7,8-	*
87-86-5	Pentachlorophenol	0.5
79-21-0	Peracetic acid	*
127-18-4	Perchloroethylene	300
108-95-2	Phenol	20
106-50-3	Phenylenediamine, p-	0.1
90-43-7	Phenylphenol, 2-	*
75-44-5	Phosgene	0.4
7803-51-2	Phosphine	0.4
7664-38-2	Phosphoric acid (as P2O5)	1
10025-87-3	Phosphorus oxychloride	0.6
10026-13-8	Phosphorus pentachloride	1
7723-14-0	Phosphorus (yellow or white)	3
85-44-9	Phthalic anhydride	0.1
88-89-1	Picric acid	0.1
2062-78-4	Pimozide	0.6
7440-06-4	Platinum - water soluble compounds	0.002
	Polybutene-1-sulphone	70
	Polychlorinated dibenzo-p-dioxins (PCDDs)	1.0E-07
	Polychlorinated dibenzofurans mixed with PCDDs	*
1336-36-3	Polychlorinated biphenyls (PCBs)	0.04
25267-15-6	Polychloroprene	300
50-32-8	Polycyclic aromatic hydrocarbons	0.003
151-50-8	Potassium cyanide	70
1310-58-3	Potassium hydroxide	1
7757-79-1	Potassium nitrate	70
1120-71-4	Propane sultone	0.002
67-63-0	Propanol, iso-	1000
71-23-8	Propanol, n-	1000
57-57-8	Propiolactone, beta-	100
123-38-6	Propionaldehyde	1
79-09-4	Propionic acid	20

C A S Number	CHEMICAL NAME	SMALL SOURCE DESIGNATION LIMIT
123-62-6	Propionic anhydride (as Propionic acid)	20
114-26-1	Propoxur	0.5
115-07-1	Propylene	*
78-87-5	Propylene dichloride	400
57-55-6	Propylene glycol	70
107-98-2	Propylene glycol methyl ether	400
108-65-6	Propylene glycol monomethyl ether acetate	1000
75-56-9	Propylene oxide	50
75-55-8	Propyleneimine	100
110-86-1	Pyridene	10
Q 91-22-5	Quinoline	*
106-51-4	Quinone	0.4
82-68-8	Quintozene	*
R Radionuclides (Radon)		*
	Reduced sulphur compounds, total (as H ₂ S)	10
S 81-07-2	Saccharin	0.002
94-59-7	Safrole	0.002
7782-49-2	Selenium	0.2
7803-62-5	Silane	7
	Silica - respirable (under 10 um aerodynamic diameter)	3
7440-22-4	Silver	0.01
7631-90-5	Sodium bisulphite	5
7775-09-9	Sodium chlorate	4
7758-19-2	Sodium chlorite	10
143-33-9	Sodium cyanide	70
1310-73-2	Sodium hydroxide	1
7757-82-6	Sodium sulphate (solution)	*
	Stannous chloride (as Sn)	6
7440-24-6	Strontium	70
1633-05-2	Strontium carbonate	70
18480-07-4	Strontium hydroxide	70
1314-11-0	Strontium oxide	70
100-42-5	Styrene	200
96-09-3	Styrene oxide	200
5329-14-6	Sulphamic acid	70
7446-09-5	Sulphur dioxide	200
2551-62-4	Sulphur hexafluoride	1000
7664-93-9	Sulphuric acid	1
T 14807-96-6	Talc - fibrous	1
13494-80-9	Tellurium - excluding Hydrogen telluride	0.1
100-21-0	Terephthalic acid	*
4559-86-8	Tetrabutylurea	6
	Tetrachlorobenzene (mixed isomers)	*
	Tetrachloro dibenzofuran (mixed isomers)	*
	Tetrachloro dibenzofuran, 2,3,7,8-	*
41903-57-5	Tetrachloro dibenzo-p-dioxin (mixed isomers)	*
	Tetrachloro dibenzo-p-dioxin, 2,3,7,8-	*
79-34-5	Tetrachloroethane, 1,1,2,2-	7
58-90-2	Tetrachlorophenol, 2,3,4,6-	*
961-11-5	Tetrachlorvinphos	*

C A S Number	CHEMICAL NAME	SMALL SOURCE DESIGNATION LIMIT
109-99-9	Tetrahydrofuran	600
137-26-8	Tetramethyl thiuram disulphide	5
7440-28-0	Thallium	0.1
62-55-5	Thioacetamide	0.002
139-65-1	Thiodianiline, 4,4'-	0.002
62-56-6	Thiourea	0.002
1314-20-1	Thorium dioxide	0.002
7440-31-5	Tin	0.1
7440-32-6	Titanium	3
7550-45-0	Titanium tetrachloride	*
35711-34-3	Tolmetin sodium	3
108-88-3	Toluene	400
584-84-9	Toluene-2,4-diisocyanate	0.04
91-08-7	Toluene-2,6-diisocyanate	*
95-53-4	Toluidine, ortho-	9
636-21-5	Toluidine hydrochloride, ortho-	*
8001-35-2	Toxaphene	0.5
68-76-8	Triaziquone	*
52-68-6	Trichlorfon	*
120-82-1	Trichlorobenzene, 1,2,4-	30
71-55-6	Trichloroethane, 1,1,1-	1000
79-00-5	Trichloroethane, 1,1,2-	50
79-01-6	Trichloroethylene	300
75-69-4	Trichlorofluoromethane	+
95-95-4	Trichlorophenol, 2,4,5-	*
88-06-2	Trichlorophenol, 2,4,6-	0.002
76-13-1	Trifluorotrichloroethane	+
1582-09-8	Trifluralin	*
75-50-3	Trimethyl amine	0.12
95-63-6	Trimethylbenzene, 1,2,4-	100
77-99-6	Trimethylol propane	700
	Tripropyltin methacrylate	0.6
126-72-7	Tris (2,3-dibromopropyl) phosphate	0.002
U 51-79-6	Urethane	0.002
V 7440-62-2	Vanadium	0.05
W		
108-05-4	Vinyl acetate	30
593-60-2	Vinyl bromide	20
75-01-4	Vinyl chloride	0.6
75-35-4	Vinylidene chloride (1,1-Dichloroethene)	20
81-81-2	Warfarin	0.1
X		
1330-20-7	Whey powder	70
108-38-3	Xylene (mixed isomers)	400
95-47-6	Xylene, meta-	0.07
106-42-3	Xylene, ortho-	400
Z		
87-62-7	Xyldine, 2,6-	*
7440-66-6	Zinc	70
7646-85-7	Zinc chloride	1
12122-67-7	Zineb	*

APPENDIX 5-2
CODES OF PRACTICE - CONCEPTUAL OUTLINE

APPENDIX 5-2

CODES OF PRACTICE - CONCEPTUAL OUTLINE

Purpose and Intent

The Ministry of the Environment currently requires certificates of approval to construct, or significantly alter sources of emissions to the atmosphere to demonstrate compliance with the Environmental Protection Act (EPA part IV and section 8). However, under the existing general air pollution regulation — Regulation 308 – Air Pollution – General — specific air emission sources are exempt from this requirement while other sources have been inadequately dealt with in the existing approvals process. There are certain necessary or unavoidable activities which are conducted infrequently or for short periods of time, and may not be capable of control using technological means. However, mitigation is called for due to the magnitude of their impact. Other activities conducted solely for the purpose of waste disposal (e.g. burning wood waste in "teepee" burners, burning railway ties) are not considered to be unavoidable and would be required to meet the general requirements of the EPA Regulations.

In order to clarify this situation the Ministry will now require subject to minor exemptions outlined below under each heading, codes of practice for the following procedures: 1) open burning for prescribed burns, fire training, testing fire retardant equipment, agricultural practices and the cleanup of spills; and 2) construction activities including highway construction and maintenance, sandblasting, demolition, material transport and drilling activities.

Codes of practice are essentially road maps for following procedural and control technology mitigation techniques. Since it is difficult to apply control technologies on many of these sources, emphasis will be placed on procedural techniques. However, some sources will be excepted from these requirements (refer to the specifics under each source heading below).

Since the purpose of establishing the codes of practice is to avoid the need to obtain certificates of approval for such activities, the lawful options facing proponents of these activities are either to seek a certificate of approval for each event or to develop and/or follow a code of practice. Where a code of practice exists for an activity, proponents of the activities covered by that code who fail to adhere to its provisions will be in violation of the Regulation.

Generally the onus will be on proponents to develop these codes of practice in order for the Ministry of the Environment to exempt them from the requirement to obtain certificates of approval. A separate code does not have to be developed for each source, some sources fall into the same or similar categories and may be developed jointly. Codes of practice as previously mentioned will be classified according to size, location and frequency of the proposed activity. For example, the division of these categories for open burning will result in twelve different codes of practice.

To determine whether a process requires its own code of practice or whether it can follow a generic code for a similar or the same practice, proponents must first determine which size, location and frequency category their operation would be classified under. If all the classification categories match another code of practice activity, the same code of practice may be used or alternately a description of the process could be sent to the Ministry and the Ministry would decide whether a separate code was necessary. All code of practice documents will be made available to the public so that comparisons can be made. The Ministry will be accountable for approving the codes and providing a consultation role in their development. Furthermore, as part of its' consultative role the Ministry of the Environment will assist in the coordination of groups and provide input into the development of these codes.

The Ministry will require the codes of practice to contain a detailed list of: 1) objectives of the practice; 2) usual practices; 3) occasional practices; 4) the location (including distance to closest dwelling, roadway and topography); and 5) the duration of the activity. Together with the lists of activities and procedures the Ministry requires a list of mitigative techniques, including mandatory (i.e., minimum) measures, and discretionary measures (i.e., extra requirements that would be prescribed as the nature of the operation warrants). Codes of practice will also be required to outline and stipulate the additional requirements described below.

The actual codes of practice will not be included in the regulation itself but instead will be included in an Appendix to the regulation. This will permit easy amendment of codes without requiring changes to the regulation itself. As information on new techniques and procedures become known, expansion and updating of these documents will be required.

Responsibility for compliance of these codes is primarily with the individuals performing these activities. However, the responsibility remains with employers and those hiring contractors to ensure that those they hire are trained in the requirements of these codes of practice and are given adequate resources to effectively mitigate emissions.

The authority to conduct activities covered by codes of practice under this regulation will not exempt or excuse the person responsible from the consequences, damages, or injuries resulting from these activities and will not exempt or excuse anyone from complying with all other applicable laws or ordinances, regulations and orders of governmental entities having jurisdiction even though the activities are otherwise conducted in compliance with the regulation.

Authorizations may be revoked by the Ministry at any time if it is determined that the activity is causing nuisance conditions to exist, the activity is not conducted in accordance with the conditions specified in the code of practice, or if the activity is in violation of any regulatory measure.

SOURCE DEFINITIONS, EXEMPTIONS AND CODE OF PRACTICE REQUIREMENTS

Open Burning

Definition and Exemptions

Open burning may be defined as burning material in an open fire or an outdoor container without controlling the combustion or the emissions of such burning. All open burning practices except for the following will require codes of practice:

- 1) fires for recreational use (campfires, ceremonial fires and barbecues);
- 2) disposal of debris during declared periods of emergency ("emergency" defined in the Emergency Plans Act means a situation caused by the forces of nature, an accident, an intentional act or otherwise that constitutes a danger of major proportions to life or property);
- 3) deliberate application of fire for the specific purpose of controlling the spread of "wild" fire
- 4) flares used to indicate danger;
- 5) burning of yard debris in remote sites where access by processing or transportation equipment is impracticable; and
- 6) small fires set for hand warming purposes, oil- and gas-fired salamanders or similar devices designated specifically for space heating or warming outdoor workers provided no visible emissions are created. (The Ministry will recommend propane gas thawing torches or other devices causing minimal pollution to be used when practicable).

Codes of practice for open burning activities as previously mentioned will be classified according to size, location and frequency of the proposed activity. The Ministry would subdivide activities into size ranges of: 1) 10 metres square and under; 2) 10 metres square to 100 metres square; and 3) 100 metres square and over. Activity frequency has been subdivided according to whether the activity occurs: 1) less than 3 times or 3 days total time in a year at a given location; and 2) more than 3 times or 3 days total time in a year at a given location. A location is considered the same if it falls within 500 m of a previous activity instigated by the same proponent. Activities will also be categorized, these will be subdivided according to their proximity to dwellings: Category 1) those that are less than 1 kilometre from a dwelling and 2) those which are farther than 1 kilometre.

Prescribed Burns

The Canadian Committee on Forest Fire Management defines prescribed burning as "the knowledgeable application of fire to a specific land area to accomplish predetermined forest management or other land use objectives" in their glossary of forest fire management terms. These are generally used for land preparation. In addition, common forestry practices use prescribed burns for reducing forest fuels, minimizing the effect of wild fires, controlling undesirable growth of hardwoods, disease control and the preparation of land for

planting and the creation of favourable habitat for wildlife. Prescribed burns are characteristically done infrequently, in remote locations, only vegetation is burned, and size of the burn is variable but usually large. In general, they have a large short-term impact.

Fire-Training Activities

Fire-training activities include fires used for training official personnel in fire-fighting techniques and will include fires used to abate an immediate fire hazard if the abatement fire is supervised by a responsible fire official. Separate codes will be required for fire training by individual groups, e.g., government and those associated with different industrial agencies. Characteristically these practices are often rural, infrequent, fuels are variable but limited, and burns are of variable duration.

Agricultural Open Burning

Agricultural open burning is the open burning of vegetation for land clearing, preparing soil for crop production, control of weeds, disease or insect infestation, denaturing seed and grain, preventing loss from frost or freeze damage. Agricultural open burning is characterized as being rural, infrequent and variable in size.

Spills

Open burning for the control of spills where there is no other practical or lawful method of disposal will be permitted, if such burning is required in order to meet the obligations for cleanup under part IX of the Environmental Protection Act provided the Ministry has been notified and expressed agreement with the plan to burn. Open burning of spilled materials is suspected of being infrequent, in various sizes and locations.

Fires Set for the Testing of Fire-Retardant Equipment

This category includes fires purposely set for the purpose of demonstrating or testing fire extinguishing materials or equipment.

Further Requirements

Open Burning codes of practice will not be considered complete unless mitigative procedures stipulate that:

- 1) except in cases of fire training activities and spills, only vegetative material must be burned; the Ministry will not allow heavy oils, items containing natural or synthetic rubber, animal carcasses or animal wastes, asphaltic products, waste petroleum, paints, plastics or any material other than dry plant growth to be open burned;

- 2) burning must be attended at all times;
- 3) burning must generally take place during daylight hours (preferably between 9:00 am. and 6:00 pm.);
- 4) burning must only commence under favourable meteorological conditions (high wind speeds, air stagnation, rainy and foggy conditions must be avoided and wind direction should preferably be away from any city, town or built-up area) and consideration must be given to possible meteorological changes during the burn;
- 5) open burning must be postponed when there is an air pollution episode as defined in the regulation until the amount of air contamination is at a more reasonable level;
- 6) open burning must not occur closer than 1.6 km. from an airport (except in the case of airport fire-training exercises), nursing home, hospital or major highway;
- 7) burning must not occur less than 800 metres from a secondary highway;
- 8) open burning must not occur closer than 460 metres from any residential, recreational, commercial or industrial area except those located on the property where the burning is to take place;
- 9) when it is necessary to open burn near a highway and the burning causes or tends to cause smoke to blow onto or across a road or highway, the person initiating the burning must post flag-persons on affected roads to ensure traffic safety; and
- 10) open burning must not be conducted on lands containing a significant peat content as determined in consultation with the Ministry of Agriculture and Food.

In addition, the Ministry will require proponents to outline: 1) The measures adopted to limit opacity through reducing the moisture content and composition of the material to be burned, 2) efforts that will be made to minimize the amount of material to be burned (salvaging), and 3) ignition technique planned.

It is important for codes of practice to be followed carefully and judgement is required for their use. The Ministry will require the training of personnel to use code of practice procedures such that the appropriate mitigation techniques are used. Ensuring that such training is provided will be the responsibility of the proponent.

Construction and Maintenance

Codes of practice will also be required for the construction, repairs, demolition, sand-blasting, crushing, screening, drilling, blasting, alterations, and the loading, unloading, sorting, handling, or transporting of materials. The emissions of concern from construction activities are mainly fugitive particulates. The Regulation requires that emissions are not to be released to an extent or degree greater than that which would result if every step necessary to control the emission of the contaminant was implemented. The following is a list of procedures which must be followed and included in codes of practice to ensure that emissions are controlled to the maximum extent. No exemptions from these requirements will be permitted but the codes of practice may indicate when certain measures may be used instead of or in combination with others. Codes of practice for these activities will also be generated separately for differing combination of size, frequency and location in a similar fashion as for open burning.

Requirements for all practices

All maintenance and construction activities must adhere to the following requirements: 1) the percent opacity from any fugitive dust source listed in section 11, Regulation 308, shall not equal or exceed 20% averaged over any six-minute period at the property line; 2) the emissions of fugitive dust shall be limited by all persons handling, transporting, or storing any material to prevent unnecessary amounts of particulate matter from becoming airborne to minimize the extent which ambient air standards described in the regulation might be exceeded; and 3) the use of these measures should not be limited to the period when actual construction work is being conducted, but also to weekends, holidays and off-hours during the week.

Control of fugitive emissions from transporting activities

Methods for controlling emissions from these sources include: 1) proper loading to prevent spillage on paved roadways; 2) maintaining the vehicle body in such a condition that prevents any leaks of aggregate material; 3) spraying the material in the vehicle with a suitable and effective dust suppressant; 4) covering haulage equipment; 5) at the site travelling booms, telescopic chutes, rotary stackers, must be used to provide adequate shrouding of openings in containers to be filled; and 6) a reduction of free-fall distance.

Roads

The control of fugitive emissions from roads may involve: 1) removal of soil and other materials, except for sand applied for the specific purpose of snow or ice control; 2) frequent watering of unpaved roads; 3) detouring; 4) use of a vacuum sweeper; 5) paving; 6) closure; and 7) speed control.

Land Disturbance

Land disturbance should be minimized and land reclaimed as soon as possible. This may involve: 1) surface compaction, 2) sealing, 3) covering 4) enclosing; 5) planting vegetation, including mulch, or selective retention of native vegetation (this vegetation will provide groundcover and a windbreak); 6) spraying with a suitable and effective dust suppressant.

Construction, alteration, demolition, drilling, blasting, crushing or screening

Codes of practice for these processes should include: 1) installation and use of hoods, fans and fabric filters to enclose, contain, capture, vent and control and clean the emissions of dusty materials; 2) sequential blasting where possible to reduce the amounts of particulate matter; 3) covering, shielding or enclosing the area; and 4) application of a suitable and effective dust suppressant.

Stockpiles

Stockpiles of materials likely to become airborne through wind action should; 1) be treated to prevent blowing of the material and/or 2) be contained in silos or other suitable enclosures. Treatment may include stabilizing the surface of such stockpiles through compacting, application of a suitable and effective dust suppressant, or asphalt sealing or covering.

APPENDIX 6

CONTAMINANT CLASSIFICATION PROCESS AND AIR QUALITY STANDARDS

APPENDIX 6-1

**OVERVIEW: CLASSIFICATION, REGULATORY
STRATEGIES AND
AIR QUALITY STANDARDS**

APPENDIX 6-1

OVERVIEW: CLASSIFICATION, REGULATORY STRATEGIES AND AIR QUALITY STANDARDS (AQS).

Aims of the Clean Air Program.

Two of the important aims of the Clean Air Program are the following. One aim is the minimization of emissions of contaminants of concern. The other, is the establishment of community Air Quality Standards (AQSs) based on various criteria (e.g., health, vegetation, etc.) and other appropriate considerations. In more complex cases, in addition to AQSs, multi-faceted regulatory strategies may be necessary to achieve satisfactory community air quality.

The general means Ontario proposes to achieve the first aim is to classify air pollutants to reflect their Level-of-Concern (i.e. Level 1, 2 & 3). Stringency of control would then be determined by this Level-of-Concern.

Target chemical list.

In order to make the task manageable and to focus on the most important air pollutants first, a CAP target list was developed for classification. In developing this list, consideration was given to the Air Resources Branch list of standards/guidelines/provisional guidelines, to the Canadian Environmental Protection Act (CEPA) Priority Substances List, to the List of Hazardous Air Pollutants developed for the Federal Provincial Advisory Committee on Air Quality (FPACAO), to carcinogen listings of the International Agency for Research on Cancer (IARC) and to 'common air pollutants'. In turn, these lists reflect the priorities of provincial and major US state air pollution agencies, other major regulatory agencies like US EPA and WHO and the priorities of industry and public interest groups by way of input to the CEPA Priority Substances List.

Classification methods.

Ontario has developed three methods of classification (See Appendix 6-3) and intends to use any one of them, depending on time constraints and available resources. All of the methods use toxicity and environmental behaviour parameters, as the basis of classification.

Two of the methods are similar, differing only in the relative amount of information gathered for consideration. They are similar in that they both utilize the MOE scoring system (See Appendix 6-2, Part 1) previously developed and similarly applied in the EMPPL/MISA process. Essentially, the scoring system assigns a numerical score to the various parameters noted above, based on the relative level of concern or importance of the information that has been gathered for that parameter in dossier form. Level-of-Concern determinations are accomplished initially, by the application of qualifying factors (i.e.,

'triggers') to the scores and finally, by the application of modifying factors. Qualifying factors (See Appendix 6-2, Part 2) are various scores and score combinations used to 'trigger' the contaminant to a particular Level-of-Concern. Modifying factors (See Appendix 6-2, Part 3) represent additional compelling information and expert judgement which may justify an enhanced or diminished Level-of-Concern.

The third method uses readily available jurisdictional (e.g., IARC carcinogen classifications;) and property (e.g., inherent persistence of metals) information with appropriate qualifying and modifying factors to make a Level-of-Concern determination.

'Interim classification' of target list.

Ontario has applied the above three methods to develop an 'interim classification' for the target list of air pollutants (See Appendix 6-4). These 'interim classifications' will be updated from time-to-time as resources permit.

Private sector driven classification process.

After this revised regulation comes into force, Ontario intends to convert most of the required information gathering (ie. dossier development) and proposal of classifications into a private sector driven process (See Appendix 6-5, Part 1). In this process 'interim classifications' or classifications 'pending review' can be updated, with the intent of revision, by proponents applying for a C. of A or by any member of the private sector who intends to appeal the classification. The means of update or appeal will be by submission to Environment Ontario of a 'Detailed Dossier' as described in the guideline document (See Appendix 6-5, Part 2), along with a corresponding proposed reclassification. In analogy with control technology determinations, Environment Ontario will review the dossier/proposed reclassification and decide on its acceptability. The final determination of the Level-of-Concern classification remains solely the responsibility of the Ministry. The process also includes other appeal mechanisms and requests for a status review of the classifications.

Regulatory Strategies, Criteria and Standards.

As noted above, another important aim of the CAP program is the establishment of community Air Quality Standards (See Appendix 6-6). Some of the data base for classifying chemicals and for recommending health or vegetation criteria with the intent of establishing AQSSs is common. Therefore, Environment Ontario intends to use the detailed dossiers, submitted under the private sector driven process, as part of the process of setting AQSSs and developing regulatory strategies.

Other features of the new process for developing regulatory strategies and setting AQSSs, besides the consideration of various criteria (e.g., health, vegetation, etc.), will include engineering evaluations to examine technological feasibility of control, development of control strategies for reducing risk to the lowest possible level especially for risk-based

health criteria, consideration of existing levels of the contaminant in the air and possibly other environmental media, emission inventory data, and legal, as well as, socio-economic considerations. Further features of this process can include, in some cases, consultative committees as required, to help develop the regulatory options available to the Ministry. Risk analysis techniques will provide the primary basis for the assessment of regulatory options and the selection of the most efficacious options available to the Ministry. It is foreseen that the Minister's Advisory Committee on Environmental Standards (ACES) will provide for both expert review, as well as, stakeholder and public consultation.

APPENDIX 6-2

THE CLEAN AIR PROGRAM (CAP)
GENERIC CLASSIFICATION PROCESS

APPENDIX 6-2

THE CLEAN AIR PROGRAM (CAP) GENERIC CLASSIFICATION PROCESS

The Clean Air Program (CAP) uses the classification of chemicals to determine appropriate control technology. The classification of chemicals into 3 Level-of-Concern groups consists of a 3 step process:

- i) Environmental Toxicity Scoring
- ii) Level-of-Concern Determination
- iii) Level-of-Concern Modification

Chemical Toxicity Scoring consists of the application of a Ministry standardized screening protocol to chemical specific toxicological and environmental behaviour information. This background data may be provided by the Ministry or may be required from the private sector for approvals. Suggested scores may be generated by the private sector; however, the final assignment of scores will be the responsibility of the Ministry. Details of the scoring system can be found in PART 1.

Level-of-Concern determination is comprised of the application of qualifying factors or 'triggers' to environmental toxicity scores. Through the application of qualifying factors the Ministry seeks to gain an indication of both relative hazard of specific chemicals, groups of chemicals or mixtures and the environmental capacity to deliver the hazard to the receptor. Chemicals are classified into one of three Level-of-Concern groups. PART 2 describes the qualifying factors or 'triggers' that suggest each classification.

Modification of the Level-of-Concern, as determined from scores, may be necessary in the case of complex environmental interactions or transport, indirect effects, synergistic effects, or a variety of other issues. The Ministry may, on a case-specific basis, promote or demote level of concern ranking for certain materials. PART 3 outlines some of the issues of concern for both promotion or demotion of level of concern classification.



PART 1: ONTARIO MINISTRY OF THE ENVIRONMENT SCORING SYSTEM

INTRODUCTION

The following generally accepted parameters have been developed to determine the concern level for a chemical in the environment. These parameters are a subgroup of the parameters in a methodology, developed for the Ministry of the Environment for assessing the relative environmental hazards of chemical contaminants. The magnitude of the score assigned to each parameter reflects the level of concern arising from that property of a chemical.

1. Environmental Behaviour Parameters

Range of scores: 0-10 for all parameters a. to c.

- a) Environmental Transport
- b) Environmental Persistence
- c) Bioaccumulation

2. Toxicity Parameters

Range of scores: 0-10 for all parameters a. to g.

- a) Acute Lethality
- b) Sub-Lethal Effects on Non-Mammalian Animals
- c) Sub-Lethal Effects on Plants
- d) Sub-Lethal Effects on Mammals
- e) Teratogenicity
- f) Genotoxicity/Mutagenicity
- g) Carcinogenicity

In addition to the numerical value assigned to a parameter, various symbols are used to indicate special concerns regarding the source of, or confidence in, the underlying data:

- If the data required are not available, an asterisk (*) is assigned to that parameter rather than a numerical score.
- If the data used are questionable (e.g., data lacking in documentation, data derived with outdated methods), a score is assigned to the parameter, but it is "tagged" with a "Q" to indicate doubt regarding the confidence in the data.
- If the data used in the assignment of a parameter score is "limited", the score for that parameter is "tagged" with an "L". This indicates that a score was assigned, but due to the nature of the readily available data, confidence in the score was less than if a more comprehensive data set had been used. In many instances, additional data would either remove the "L" designation and confirm the score, or result in a higher score.

"L" was also used if, in the absence of a freshwater fish BCF, log kow was used to score bioaccumulation.

- If the data used are perceived as representing a worst-case scenario (e.g., toxicity data from intravenous administration), the score for that parameter is "tagged" with a "W".

If the data used in the assignment of a parameter score are estimated from environmental modelling techniques or structure-activity relationships, the score for that parameter is "tagged" with an "E".

These "tags" may be taken into consideration when the chemical is reviewed.

PARAMETERS

1. Environmental Behaviour Parameters

(a) ENVIRONMENTAL TRANSPORT

Rationale

This parameter describes the transport of chemicals between environmental media. The environmental transport of a chemical is an important factor in evaluating its potential environmental and health hazards. Inter-media transport can be observed during field studies or by undertaking microcosm studies in a laboratory, but relatively few substances have been studied using such techniques. One way to estimate the environmental transport characteristics of a chemical is to use a simple mathematical model such as the Fugacity Level I model (MacKay and Paterson).

The Fugacity Level I model estimates the equilibrium distribution of a chemical released to the environment. The environmental media considered are air, water, soil, sediment and aquatic biota. The model requires information about the chemical's physicochemical properties, i.e. molecular weight, solubility, vapour pressure, and octanol-water partition coefficient.

Scoring Criteria

The criteria for this parameter use results from environmental models. In addition, there are criteria for substances that are largely associated with fine particles (generally less than 10 µm in size). Examples are fine particles associated with incinerator processes.

The scoring criteria for this parameter are as follows:

PARAMETER SCORE	CRITERIA
10	Three or more media each contain > 5% of the total amount released or substance is inorganic and is adsorbed to particles <10um in diameter when released.
7	Two media each contain > 5% of the total amount released.
4	No one medium contains > 95%, and only one medium contains > 5% of the total amount released.
0	Any single medium contains > 95% of the total amount released.

Suggested Information Sources

Lyman et al., 1982 -

A comprehensive reference of published values and estimation methods for various physical and chemical properties.

Verschueren, 1983 -

A handbook of environmental data for organic chemicals.

ENVIROFATE and ISHOW databases -

Contain solubility, vapour pressure, partition coefficients for many chemicals.

ICF Inc., 1985 -

Contains tabulations of physical, chemical and fate data for many organic substances and elements.

Mills et al., 1982 -

A compilation of physical, chemical and fate data for many organic substances.

Mackay and Shiu, 1981 -

A compilation of physical and chemical parameters for organic substances.

Kenaga and Goring, 1980 -

A compilation of solubility, sorption and K_{ow} data.

Clayton and Clayton, 1981 -

A comprehensive reference of information on industrial chemicals.

Karickhoff, 1984 -
Discussion of sorption processes in general and K_{ow}/K_{oc} values in particular.

Amoore and Hautala, 1983 -
Information on volatilities of industrial chemicals.

Neely and Blau, 1985 -
Contains physical, chemical and fate data and estimation methods.

(b) ENVIRONMENTAL PERSISTENCE

Rationale

This parameter describes the tendency for a chemical to persist in the environment. Substances in the environment can be subjected to a variety of processes including sorption, oxidation, hydrolysis, photodegradation and biodegradation. The net result of such processes may be expressed as the overall persistence of a substance in the environment. When quantified, persistence is usually expressed as the length of time required for one-half of the original amount of a substance to be degraded. It is analogous to parameters which may be presented as "rate of loss in natural systems", "overall half-life", or "50% recovery time". It is also similar to the "persistence" parameter calculated by fugacity models.

Half-lives of chemicals may vary from seconds to thousands of years (ICF Inc., 1985). Short half-lives generally indicate a lower level of concern. For example, environmental releases of substances with half-lives of less than a few days often will not result in significant accumulation in the environment. Conversely, those with half-lives of several months or longer can lead to substantial exposure or accumulation in the food chain.

Scoring Criteria

The criteria for this parameter are based on half-life values.

If half-life data are available, they will usually pertain to specific media as opposed to general environmental persistence. This information provides an indication of levels of concern regarding specific media. In such cases, it is recommended that the media providing the highest score be used.

If persistence values have not been reported and cannot be estimated by using environmental models, other types of information may offer guidance in developing a score for this parameter.

For example, structure-activity relationships (SARs) may provide general indications of persistence for relatively unknown substances structurally similar to more familiar substances.

To assess the potential biodegradability of substances in wastewater treatment plants, test methods such as the static-culture-flask and shaker-flask techniques have been used (for example, see Tabak et al., 1981). The results of these tests in general show good agreement with published work on biodegradability. Substances not degraded under test conditions cannot be presumed to be immune to microbial action in the environment. Accordingly, scores derived from SARs or biodegradability tests should be tagged with E, Q, or W.

PARAMETER SCORE	CRITERIA
10	Half-life greater than 100 days
7	Half-life of more than 50 but less than or equal to 100 days.
4	Half-life of more than 10 but less than or equal to 50 days
0	Half-life of less than or equal to 10 days.

Suggested Information Sources

ICF Inc., 1985 -

Includes compilation of half-lives in several media for organic substances.

Mills et al., 1982 -

Includes compilation of half-lives in aquatic media for organic substances.

Verschueren, 1983 -

Includes half-lives and biodegradability test results for organic substances.

NRCC - (National Research Council of Canada Associate Committee on Scientific Criteria for Environmental Quality) -

These publications include data on biodegradability for specific substances.

ENVIROFATE database -

Contains data on biodegradation rates for chemicals released to the environment.

Tabak et al., 1981 -

Includes results of biodegradability studies for more than 100 organic substances.

(c) BIOACCUMULATION

Rationale

This parameter describes the tendency for a substance to accumulate in biological systems. In the current context, the term bioaccumulation is intended to convey the ability of a substance to accumulate in the tissues of organisms. The tendency for certain groups or classes of chemicals to bioaccumulate is well documented. This process has also been referred to as bioconcentration or biomagnification and some authors have assigned various distinct definitions to these terms but for purposes of this assessment those differences are relatively unimportant.

One of the parameters frequently used to express bioaccumulation is the bioconcentration factor (BCF). Most BCF values pertain to fish or other aquatic organisms and are calculated as the ratio of the concentration of a substance in the organism (or some specific tissue) on a wet weight basis to the concentration of the substance in the water at steady state (Veith et al., 1980). For organic substances, values of BCF range from about 1 to more than 1,000,000 (Lyman et al., 1982).

Bioaccumulation factors have also been determined for some terrestrial vertebrates but these data are less abundant and more difficult to locate than those for aquatic organisms. It is recommended for this assessment that data collection efforts first focus on BCF values for aquatic organisms.

The tendency of substances to bioaccumulate in tissue frequently has been related to hydrophobicity or lipophilicity (Veith et al., 1980). As a result, various regression equations have been suggested for predicting BCF values for aquatic organisms based on the octanol-water partition coefficient (K_{ow}) and other physico-chemical properties. To date, those that use K_{ow} values have been the most widely investigated and most successful (Lyman et al., 1982; Geyer et al., 1984).

Scoring Criteria

Scoring criteria for this parameter are defined in terms of either BCF or $\log K_{ow}$. The correlation between the two sets of criteria is based upon the following relationship developed from experimental data on 84 chemicals (Veith et al., 1980):

$$\log \text{BCF} = 0.76 \log K_{ow} - 0.23$$

Other equations have been developed based upon various groups of chemicals. If an equation is available that is more directly applicable to a substance being evaluated, that equation can be used.

The bioaccumulation of compounds with relatively high K_{ow} values is influenced by the degree to which a compound dissociates in water. Equations for estimating bioaccumulation that include a dissociation term have not been reported. For this parameter, dissociation has not been considered in the determination of scores. This

should tend to produce somewhat higher scores than warranted for some organic substances. BCF values can be estimated only to within an order of magnitude using most of the correlations developed to date, and laboratory test situations are incapable of duplicating field situations (Lyman et al., 1982). Therefore, the consideration of dissociation effects may be unimportant, for this evaluation.

If scores based on both the BCF and the K_{ow} can be determined, preference should be given to the measured BCF values rather than those estimated based on K_{ow} .

PARAMETER SCORE	BCF	CRITERIA	$\log K_{ow}$
10	>15000		>6.0
7	>500 - 15000		>4.0 - 6.0
4	>20 - 500		>2.0 - 4.0
0	20		2.0

Suggested Information Sources

Lyman et al., 1982 -

Contains BCF and K_{ow} data and estimation methods.

Geyer et al., 1984 -

Examines relationship between BCF and K_{ow} .

Kenaga and Goring, 1980 -

Includes Kow and BCF data for aquatic environments.

Verschueren, 1983 -

Includes BCF and Kow data for organic substances.

Veith et al., 1980 -

Includes BCF and Kow values.

AQUIRE database -

Contains BCF data for aquatic organisms.

Mackay, 1982 -

Examines correlations of BCFs.

Garten and Trabalka, 1983 -

Contains BCF data for data for aquatic and terrestrial organisms.

ICF Inc., 1985 -

Includes BCF data.

Hansch and Leo, 1979 -
Describes how to estimate Kow values.

2. Toxicity Parameters

Parameters "a" through "h" were selected to describe the toxicological properties of chemicals. Information on acute lethality of chemicals to all targets in the environment is included in parameter "a". The sub-lethal effects of chemicals on ecological systems (plants and animals) are described in parameters "b" and "c". Parameters "d" through "f" are primarily designed to describe potential adverse effects on human health.

When data are lacking on the effects of a chemical on a specific environmental target (e.g., humans, fish or wildlife) the best available information should be used. Unless specific data are available on species differences in responses to the chemical, it is assumed that all species respond in an equivalent manner and the most sensitive would be used in scoring. Differences in response among species, or other differences between experimental and "real-world" exposure situations (e.g., data from high level experimental exposures extrapolated to much lower levels) are not considered in this assessment.

There are several general topics, including route and duration of exposure and validity of testing procedures, that apply equally to all of the toxicity parameters. These are discussed below and will only be briefly referred to in the descriptions of each parameter.

Route of Exposure

Route of exposure is an important factor in the judgement of the applicability and validity of the effects observed under controlled experimental conditions (Grice, 1984; Willes et al., 1985). In terrestrial animals, oral, inhalation and dermal routes of exposure are considered the most representative of "real-world" exposures. In aquatic species, the usual route of exposure is through water. In plants, exposures usually occur through soils or from the atmosphere. In all test systems, data derived by direct application of chemicals to biological systems (e.g., direct injections into tissues) that by-pass normal absorption and uptake systems may indicate the potential for the production of adverse effects but their relevance to normal exposures should be carefully evaluated. In addition, the use of vehicles (e.g., dimethylsulfoxide) in dermal exposure studies can substantially increase the uptake of chemicals through the skin and, although the results would indicate a worst-case assessment of potential effects, their relevance to usual dermal exposure is questionable. In all of the toxicity elements the scorer must exercise judgement in the use of data derived from unusual exposure routes. If such data are the only information available they may be used, but, at the very least the scores assigned require appropriate "flags" (e.g., Q or W or E).

Duration of Exposure

The duration of exposure is important in the assessment of potential effects of chemicals on the environment and health (Hushon and Kornreich, 1984). Acute lethality is usually assessed following a single exposure (e.g., LD50, LC50), or following a short duration of exposure (e.g., acute tolerance tests or 96-hour LC50 tests in aquatic species). The assessment of long term effects usually involve multiple exposures for the major portion of the lifespan of the test system (FDA, 1982). This is usually considered a minimum of one year in terrestrial animals (FDA, 1982), but may be as short as a few days in certain short-lived aquatic and plant test systems.

In the assessment of long term effects of chemicals, judgement is required to determine if the duration of exposure and observation in the studies was adequate both to achieve a steady state level of the chemical in the system and to encompass the latency period for the development of adverse effects. The biological half-life of the test chemical can assist in judging whether steady state levels of the chemical in the test system were achieved. For example, a minimum of 3.5 half-lives are generally required to reach 99% of the steady state body burden (FDA, 1982; Willes et al., 1985).

The latency period between the initiation of exposure and the development of particular adverse effects depends on the type of effects produced, in addition to the time required to achieve a steady state body level. Effects related to general narcotic actions of chemicals generally have much shorter latency periods (e.g., several hours) compared to cancer where latency periods range from months to years (Grice 1984; Willes et al., 1985).

If adequate long term exposure data are not available, scores for toxicity elements addressing long term effects may be estimated from shorter term exposure data. In terrestrial animals, data from exposures of 90+ days may provide reasonable estimates of certain long-term effects, although the validity of extrapolating such data to predict chronic effects requires considerable judgement. Judgement is even more critical when estimates of potential chronic effects are made by extrapolation of data from various short-term in vivo or in vitro test systems (Grice, 1984; Willes et al., 1985). It is not possible nor desirable to overly complicate a scoring system by incorporating all the uncertainties of extrapolating data from shorter to longer exposure scenarios. Therefore, as a general rule, when effects related to long term exposure are estimated from short term exposure data, the scores derived require appropriate "flags" (e.g., W, Q or E) indicating uncertainty in the assigned score.

Validity of Testing Procedures

The assignment of scores to the various toxicity parameters requires that the scorer assess the validity of the procedures followed in the collection of the toxicological data. It is beyond the scope of this scoring system to provide details of adequate procedures for the myriad of ever-changing tests available. The following references outline current standard procedures used in the collection of toxicological data: Grice

et al., (1975); IARC (1980); FDA (1982); EPA (1984); NTP (1984); OSTP (1985). The validity of new testing procedures can usually be determined from publications by recognized authority centres around the world (e.g., Health and Welfare Canada, U.S. EPA, U.S. FDA, WHO, OECD, IARC).

(a) ACUTE LETHALITY

Rationale

This parameter describes the acute lethality of a chemical to terrestrial and aquatic animals. Non-lethal or reversible effects are not included in this element. Acute effects other than lethality (e.g., irritation, allergic reactions, general narcosis, etc.) are considered in other toxicity elements. Criteria for phytotoxicity are not included in this element because of the difficulties in assessing lethality in plants.

Scoring Criteria

Scoring criteria for acute oral and dermal LD50s and inhalation and aquatic LC50s are similar to those utilized by the Transportation of Dangerous Goods Act (DOT, 1984) and the State of Michigan Critical Materials Registry (Michigan, 1979). Scores of six down to zero for oral and dermal LD50s are comparable to the extremely toxic to relatively non-toxic scales outlined in the literature (Hodge and Sterner, 1949; Gleason et al., 1977; Doull et al., 1980). The criteria for scores of 8 to 10 would identify chemicals with greater toxicity than those included in the scales referred to above. These more stringent criteria were adopted to ensure chemicals with extreme acute lethality are clearly identified by the scoring system.

The scoring criteria for inhalation LC50s are derived from the oral LD50 criteria, assuming a 60 kg individual respires 20 m³ of air daily and that the contaminants have equal biological availability via the oral and inhalation routes of exposure. The aquatic toxicity LC50 data would usually be derived from 96-hour exposures.

Scoring criteria for this parameter are as follows:

PARAMETER SCORE	CRITERIA			
	Oral LD50 (mg/kg)	Dermal LD50 (mg/kg)	Inhalation LC50 (mg/m ³)	Aquatic LC50 (mg/L)
10	0.5	0.5	1.5	0.1
8	>0.5 - 5	>0.5 - 5	>1.5 - 15	>0.1 - 1
6	>5.0 - 50	>5.0 - 50	>15 - 150	>1 - 10
4	>50 - 500	>50 - 500	>150 - 1500	>10 - 100
2	>500 - 5000	>500 - 5000	>1500 - 15000	>100 - 1000
0	>5000	>5000	>15000	>1000

Suggested Information Sources

ACQUIRE database -

This database contains acute lethality values for aquatic and terrestrial species.

Hayes, 1982 -

Contains information on the toxicology of pesticides and associated chemicals with particular reference to effects in humans.

Ketchen and Porter, 1979 -

These Critical Material Data sheets summarize information on the toxic potential of individual chemicals, including acute lethality data, in terrestrial species.

Merck Index -

The Merck Index lists indices of toxicity for many chemicals in terrestrial species.

MEDLINE database -

A computerized database presenting titles and abstracts of published, worldwide, biomedical literature.

Clayton & Clayton, 1981 -

Summarizes the toxic characteristics of a large number of industrial chemicals, primarily in terrestrial species.

(b) SUB-LETHAL EFFECTS ON NON-MAMMALIAN SPECIES

Rationale

This parameter describes potential effects from long-term exposures of non-mammalian species to chemicals. The effects-data may be expressed as median effect concentration (EC50), maximum aquatic toxic concentration (MATC) or no-observed-adverse-effect-concentration (NOAEC).

The most frequently reported data of these types are EC50 values for fish or other aquatic organisms such as daphnia. Associated with an EC50 value is the species studied, the endpoint(s) observed, and the duration of exposure. Common endpoints are immobilization, loss of equilibrium, effects on reproduction and other sub-lethal effects. As with other parameters, if different indicators of effects are available, the most sensitive would be used, unless scorer judgement indicates otherwise.

As with mammalian toxicity, duration of exposure is important to the interpretation of the results. For aquatic organisms, either full or partial life-cycle tests are preferred for the assessment of reproductive effects. Such tests may last as few as seven days or extend beyond a year depending on the life cycle. For terrestrial animals, periods of exposure usually last several months. For other types of effects, results from

96-hour exposures generally have more credence than shorter exposures. In addition, preference should be given to tests on freshwater species native or introduced to North America.

Scoring Criteria

Based on published results of the effects of many substances on aquatic organisms, the NOAEC values that appear in the score definitions are a factor of 100 lower than EC50 values (Konemann and Visser, 1983). Maximum Aquatic Toxic Concentration (MATC) values are 10 times lower than EC50 values.

The scoring criteria for this parameter are as follows:

PARAMETER SCORE	CRITERIA - AQUATIC ORGANISMS	TERRESTRIAL ORGANISMS
10	EC50 0.02 mg/L; OR MATC 0.002 mg/L; OR NOAEC 0.0002 mg/L in different genera.	Adverse effects at 1 mg/kg for sub-chronic exposure OR 0.5 mg/kg for chronic exposure, in different genera.
8	EC50 0.02 mg/L; OR MATC 0.002 mg/L OR NOAEC 0.0002 mg/L in one genus only.	Adverse effects at 1 mg/kg for sub-chronic exposure OR 0.5 mg/kg chronic exposure, in one genus only.
6	EC50 0.02 - < 0.2 mg/L; OR MATC 0.002 - < 0.02 mg/L; OR NOAEC 0.0002 - < 0.002 mg/L	Adverse effects at > 1-10 mg/kg for sub-chronic exposure OR > 0.5-5 mg/kg chronic exposure.
4	EC50 0.2 - < 2 mg/L; OR MATC 0.02 - < 0.2 mg/L; OR NOAEC 0.002 - < 0.02 mg/L.	Adverse or non-adverse effects at > 10-100 mg/kg for sub-chronic exposure OR > 5-50 mg/kg for chronic exposure.
2	EC50 2 - < 20 mg/L; OR MATC 0.2 - < 2 mg/L; OR NOAEC 0.02 - < 0.2 mg/L.	Adverse or non-adverse effects at > 100-1000 mg/kg for sub-chronic exposure OR > 50-500 mg/kg for chronic
0	EC50 20 mg/L; OR MATC 2 mg/L; OR NOAEC 0.2 mg/L.	Adverse or non-adverse effects at 1000 mg/kg for sub-chronic exposure 500 mg/kg for chronic exposure.

Suggested Information Sources

AQUIRE database -

AQUIRE has EC50 and/or NOAEC data for aquatic organisms for some organic chemicals.

Most information required for this element must be sought from primary sources identified through literature searches.

(c) SUB-LETHAL EFFECTS ON PLANTS

Rationale

Sub-lethal effects on plants are highly varied depending on the toxicant. The relative significance of the injury or effect depends on the commodity and its use. These can be divided into three categories.

- A The appearance is important, but growth and yield are of much less importance. This is relevant for ornamentals, flower crops, leafy vegetables and fruit.
- B The impact on growth and yield are the most significant, and visible injury to the foliage, though unsightly, is of less importance. This is relevant for vegetables, fruits, seeds and storage organs such as tubers.
- C There are no visible injurious effects but the longevity of the commodity has been altered. This is of greatest significance in flower crops and storage of fruit and vegetables.

The toxic effects can generally be assayed using short term tests with indicator plants. The possible effects include a wide spectrum of responses: inhibition of germination, inhibition of seedling growth, growth abnormalities, reduction in either root or shoot growth, etc. Long term tests with annual plants may be used to assess chronic effects such as decreased yield or decreased competitiveness (NAS, 1975).

The most commonly tested aquatic plants are algae and duckweed (*Lemna minor*) (U.S. EPA, 1978). Several test methods have been developed that use algae (for example, the U.S. EPA Algal Assay Bottle Test). Duckweed has been used to assess the effects of substances on aquatic macrophytes, (EPA, 1978).

Effects on the genetic make up of the organism may be assayed using other short term tests with plant material. These include gene mutations, DNA repair, primary DNA damage and chromosomal aberrations (Sandhu, 1980). Some examples of genetic mutation assays using plants are the measurement of chromosomal aberrations in root tip cells, the *Tradescantia* micronucleus assay (Sandhu, 1980) and the use of *Arabidopsis* for measuring the frequency of mutational events at the embryo stage (Redei, 1980).

Scoring Criteria

The score definitions for aquatic plants are very similar to those used in parameters which address sub-lethal effects on aquatic animals.

Various biomonitoring techniques have been used for different contaminants with each species displaying characteristic symptoms for a given pollutant. Some of these tests have been standardized to a substantial degree while others are only qualitative indicators. Standardized sampling methods have also been devised for substances that accumulate

in vegetation and that are toxic to animals. Lichens are also used for a variety of contaminants, both as indicators by presence or absence, or are used as accumulators.

Standardized tests have been reported for relatively few substances. In some cases, the scoring system can accommodate results expressed in concentration units (mg/L for substance in water, mg/m³ for gaseous contaminants, and mg/kg for substances in the soil), but in most instances, the length of exposure time is very important. It is thus necessary to link the persistence or the number of releases or the length of exposure to this element in some way through the use of appropriate combining rules.

Precautions. Soil extraction procedures are critical in determining the level of a toxicant, e.g., the total amount removed by acid extraction may no be meaningful in relation to plant bioavailability.

The scoring criteria for this element are as follows:

PARAMETER SCORE	MEDIUM**	CRITERIA*		
		<5% EFFECT OR NOAEL	>5-50% EFFECT OR EC ₅₀	>50% EFFECT
10	WATER AIR & SOIL	<0.001 <0.01	<0.01 <0.1	<0.1 <1
8	WATER AIR & SOIL	0.001-0.01 0.01-0.1	0.01-0.1 0.1-1	0.1-1 1-10
6	WATER AIR & SOIL	>0.01-0.1 >0.1-1	>0.1-1 >1-10	>1-10 >10-100
4	WATER AIR & SOIL	>0.1-1 >1-10	>1-10 >10-100	>10-100 >100-1000
2	WATER AIR & SOIL	>1-10 >10-100	>10-100 >100-1000	>100-1000 >1000-10000
0	WATER AIR & SOIL	>10 >100	>100 >1000	>1000 >10000

* Effects considered: Reduction in growth, total biomass or photosynthesis

** Units: Water - mg/L
Air - mg/m³
Soil - mg/kg

Suggested Information Sources

Manning and Feder, 1980-

Discusses the use of plants as monitors of pollution.

Lepp, 1981 -

Discusses effects of heavy metals in plants.

Martin and Coughtrey, 1982 -

Discusses effects of heavy metals on biota as indicators of pollution.

NRCC -

Publications of the Associate Committee on Scientific Criteria for Environmental Chemistry includes data on effects on plants.

Levitt, 1980 -

Reviews environmental stress on plants.

Ormrod, 1978 -

Reviews effects of pollution on horticulture.

Information will have to be sought from primary sources for many of the toxicants.

(d) SUB-LETHAL EFFECTS ON MAMMALS

Rationale

This parameter describes potential longer-term effects of chemicals in mammals. The effects are directed primarily at human health, although the actual data used will largely be from laboratory animals. Other scoring systems (see Hushon and Kornreich, 1984) generally score chemicals for sub-lethal toxicity based on specific effects (e.g., separate scores for carcinogenicity, mutagenicity, teratogenicity, etc.), but most do not address systemic toxic effects. The toxic effects included in this parameter are restricted to sub-lethal systemic effects, but do not include carcinogenic, mutagenic or teratogenic effects since these are included in other parameters.

Scoring Criteria

If data are not available on the effects following a suitable duration of exposure, either appropriate "tags" (W, Q or E) should be used, or, preferably, the criteria should be divided by an appropriate extrapolation factor to adjust for potential effects that would not develop during shorter exposure studies. Criteria used in the development of scores for this parameter would be derived from sub-chronic (generally 90-day exposure) or chronic (usually 1 year or more) exposure studies in any mammalian species (refer to the general discussion of exposure duration). If the data were derived from sub-chronic studies, of less than 90 days, it is recommended that the NOAEL be divided by a 10-fold extrapolation factor (see FDA, 1982; Dourson and Stara, 1983). If the only data available involved even shorter term exposures (e.g., 14 days), it is recommended that a 100-fold extrapolation factor be used.

Considerable judgement will be required in the utilization of such extrapolation factors, considering issues such as the biological half-life of the chemical, the biological characteristics of the test system from which the data was derived, and knowledge of the usual consequences of the type(s) of lesions produced.

The scoring criteria for this parameter do not provide for differences in the type of toxic response observed. For example, if the effects associated with exposure are irreversible, the consequences of exposure are much more serious than if the effects reverse following cessation of exposure. For the purposes of this assessment, all effects are considered as equal but details of differences in the severity of the effects would be carefully noted.

Examples of the various end-points included as chronic systemic effects are as follows:

Reproduction toxicity

- Adverse effects on reproduction as they affect the survival, development and well-being of the species, including interference with gonadal functions but excluding teratogenic effects.

General toxicity

- General depressions in body weight and body weight gains, general behavioral alterations and increases in diseases secondary to chemical exposure.
- Gross or microscopic alterations indicative of disease from toxic events.
- Adverse or deleterious effects on organ systems or functions, alterations in secretions of exocrine and endocrine glands, alterations in the brain and peripheral nervous systems.
- Treatment related biochemical effects.

If data are available on more than one of these effects, the effect occurring at the lowest exposure level in the most sensitive test system should be used in scoring. In addition, structure-activity relationships may provide estimates of the occurrence of chronic effects if data on the actual compound are lacking.

Structure-activity relationships appear reasonably predictive for certain types of effects (e.g., narcotic effects), however, little predictive value is obtained for other effects using available methods. In the future, the accuracy of structure-activity relationships in predicting effects between different chemicals may improve.

Even with present methodologies, however, an estimation of potential effects may prove more valuable than accepting a judgement of inadequate information. Such estimates, however, would be appropriately "flagged" with a Q or E.

The scoring system for this parameter is as follows:

PARAMETER SCORE	CRITERIA*	
	ORAL NOAEL mg/kg	INHALATION NOAEL mg/m ³
10	0.1	0.3
8	>0.1 - 1	>0.3 - 3
6	>1 - 10	>3 - 30
4	>10 - 100	>30 - 300
2	>100 - 1000	>300 - 3000
0	>1000	>3000

* Criteria are based on data from exposures of 90 days or more in duration. If data from studies of this duration are not available, data from shorter-term studies may be used provisionally with the following modifications: If data from studies of 28-<90 days duration are used, divide the data values by 10; If data from studies of <28 days duration are used, divide the data values by 100.

Suggested Information Sources

Most of the information on the toxic effects associated with chronic exposure to chemicals would be obtained from original scientific publications which could be accessed through the MEDLINE and TOXLINE databases. Additional sources of summary data include Ketchen and Porter (1979), Clayton and Clayton (1981), RTECS database, and Verschueren (1983). It should be emphasized however, that the judgement of the validity of a NOEL from summary data is difficult and that original publications should be consulted.

(f) TERATOGENICITY

Rationale

This parameter describes the potential teratogenic effects of chemicals on mammalian systems. Toxic effects on reproduction in plants, non-mammalian and mammalian systems, as distinct from developmental defects, are described in parameters b, c, and d. The production of terata by exposure to chemical contaminants can seriously compromise the development and survival of offspring. Such effects are usually irreversible, although current understanding is that they have an exposure threshold (EPA, 1984).

The criteria for these effects are as outlined by the U.S. Environmental Protection Agency (EPA, 1984). Teratogenic effects include frank developmental malformations detrimental to the survival, future development, or well-being of newborn. They do not include developmental anomalies and aberrations that appear to be secondary to embryo-, feto- and maternal toxicity (see EPA, 1984; Khera, 1981). Many such effects are known to recover as development proceeds (e.g., reversible delayed

ossification of various parts of the skeleton, delayed development of specific organs, delayed eye opening, delayed vaginal opening, reduced body weight) (Khera, 1981). In some cases, exposure of pregnant females to chemicals can result in malnutrition due to decreased feed intake. Malnutrition has been shown to delay embryo and fetal development, reduce birth weights and, in severe cases, produce irreversible neurological and metabolic abnormalities (EPA, 1984; Khera, 1984). These differences in the apparent severity between frank terata and minor developmental anomalies from chemicals are reflected in the scoring criteria for this element.

Behavioural teratology is a rapidly developing sub-field of teratology and includes effects related to alterations in the behaviour of the offspring as they mature. In some cases behavioural effects may not be evident until maturity (e.g., effects on sexual behaviour). Other effects may only be temporary and actually disappear at some later stage of development. No specific criteria have been included in this parameter for behavioural teratogenic effects and judgement must be exercised to determine how such effects "fit" into the criteria provided. As the significance of such effects is better understood, alterations in the criteria for this parameter may be required to encompass the increase in knowledge.

Scoring Criteria

Working from the assumption that teratogenic effects exhibit exposure thresholds (Khera, 1981; EPA, 1984), scoring criteria are based on gradations in exposure levels associated with effects. Since teratogenic effects are viewed as more serious than developmental anomalies as outlined above, higher scores are applied to chemicals showing evidence of frank teratogenicity. Chemicals producing developmental anomalies and aberrations are assigned lower scores (e.g., delayed ossification of bone, decreased fetal weights, decreased birth weights, prolonged gestation, decreased survival without abnormalities, developmental effects that reverse during postnatal development).

Duration of exposure is particularly critical in assessing teratogenic effects. To adequately assess the potential for such effects from a chemical exposure should occur at least through the period of organogenesis (e.g., usually from late in the first trimester through early in the third trimester of gestation). In addition, the levels of exposure studied should be sufficient to elicit a range of effects in the dams, from toxicity at the higher exposures to no-observable effects at the lower exposures (Grice et al. 1975; EPA, 1984; Khera, 1981).

The general requirements regarding route of exposure discussed earlier also apply to teratogenicity assessments.

The scoring criteria for this parameter are as follows:

PARAMETER SCORE	CRITERIA
10	- Teratogenic effects observed without overt maternal toxicity at maternal exposures 0.1 mg/kg/day during organogenesis, or equivalent exposure*
8	- Teratogenic effects observed without maternal toxicity at maternal exposures >0.1 - 1 mg/kg/day during organogenesis or equivalent exposure
6	- Teratogenic effects or developmental anomalies observed at maternal exposures >1 - 10 mg/kg/day during organogenesis or equivalent exposure
4	- Teratogenic effects or developmental anomalies observed at maternal exposures >10 - 50 mg/kg/day during organogenesis or equivalent exposure
2	- Teratogenic effects or developmental anomalies observed at maternal exposures >50 - 1000 mg/kg/day during organogenesis or equivalent exposure
0	- No terata observed, or observed only at maternal exposures of 1000 mg/kg/day or equivalent exposure

* Equivalent exposure by inhalation or dermal routes, assuming 100% absorption and that effects by dermal exposure would occur at comparable doses to oral exposure. Total dose via inhalation is to be converted to an equivalent to an approximate daily oral dose equivalent exposure by the use of appropriate factors (eg. ppm to mg/m³ and physiological standards such as a 70 kg adult human respires 20 m³ of air per day or a 275g female rat respires 0.17 m³ of air per day). These assumptions mean that the dermal and oral exposure levels are equivalent, and inhalation exposures (in mg/m³) are obtained by multiplying the oral exposure by three.

Information Sources

Most of the information on the teratogenic effects associated with exposure to chemicals can be obtained from original scientific publications which can be accessed through the MEDLINE and TOXLINE databases. Additional sources of summary data include Ketchen and Porter (1979), Clayton and Clayton (1981), RTECS database, and Verschueren (1983). Care should be exercised in using the RTECS date base since only studies showing positive effects associated with exposure are reported. It must also be emphasized that the judgement of the validity of teratogenic effects (e.g., the evaluation of frank developmental anomalies versus developmental aberrations) from summary data is difficult and that original publications should be consulted.

GENOTOXICITY/MUTAGENICITY

Rationale

This parameter describes the mutagenic and genotoxic potential of a chemical. Such effects in themselves are indicative of potential hazards of chemicals to health and the environment. In addition, the strength of such evidence is valuable in the interpretation of other potential hazards from chemicals (e.g., carcinogenicity).

Genotoxic or mutagenic effects on somatic or germ cells are considered equal potential hazards. Evidence of heritable mutations (i.e., mutations in germ cells) was regarded as more indicative of the test system studied and ability of a chemical to distribute to germ cells (i.e., the disposition of the chemical *in vivo*) rather than of a greater potential hazard. In addition, assessment of the potential for germ cell mutations requires specific tests (e.g., dominant lethal test, mouse heritable translocation assay) and results from such tests are not available for large numbers of chemicals. Therefore, specific scoring criteria for germ cell mutations would increase the dependency of the resulting prioritization of chemicals on the information available rather than indicators of potential hazard. In the scoring criteria used, chemicals for which evidence of germ cell mutations are available would receive high scores, however, not preferentially higher than chemicals with evidence of somatic mutations only.

Scoring Criteria

The criteria assign higher scores to chemicals with adequate evidence of mutagenic/genotoxic effects derived from short-term tests. The primary objective is to score the potential of a chemical to produce such effects.

Chemicals producing direct mutagenic/genotoxic effects in the absence of overt toxicity are assigned the highest scores (e.g., the chemical or its activated metabolite(s) directly acts on genetic material to produce mutations or genotoxic effects). Clastogenic effects produced by chemicals that do not directly interact with genetic material are scored in the next category. Chemicals causing mutagenic or genotoxic effects indirectly by interfering with various cellular systems would receive lower scores. Scores of two or four should be assigned to chemicals having positive evidence from certain test systems but clear evidence of lack of effects in other test systems.

It is assumed that all test data will be derived under optimal experimental conditions (e.g., using validated test procedures, including appropriate S-9 metabolic activating systems, adequately controlling for unusual chemical/physical characteristics of the test chemicals). Acceptable tests include, but are not necessarily limited to, the following:

a) *in vitro* gene mutation

- Salmonella/mammalian microsome assay
- CHO/HGPRT - assay
- L5178Y TK - assay
- Haploid *Saccharomyces* assay

b) *in vitro* mammalian chromosomal aberrations

- metaphase analysis in mammalian cells exposed *in vitro* (not including sister chromatid exchange and micronuclei)

- c) in vivo mammalian chromosomal aberrations
 - rodent bone marrow micronucleus assay
 - rodent bone marrow metaphase analysis (not including sister chromatid exchange)

- d) in vivo mammalian gene mutation or indicator tests in a second somatic tissue
 - rodent liver unscheduled DNA synthesis
 - rodent sister chromatid exchange

Data from other tests may be used with appropriate justification. There will be many chemicals for which adequate information for this parameter is lacking or incomplete. The use of structure-activity relationships in developing scores for this parameter may be a viable alternative in the future, however, at present such concepts are only in their formative stages (FDA, 1982; NTP, 1984; OSTP, 1985). Consequently, considerable expertise and judgement are required to assign scores based on structure-activity information, and such scores would require appropriate "flags" to signify the level of confidence in the data used (e.g., W, Q, E).

The scoring criteria for this parameter are as follows:

PARAMETER SCORE	CRITERIA
10	Conclusive evidence of mutagenicity or genotoxicity in recognized prokaryotic or eukaryotic test systems at exposure levels not producing overt toxic effects (in vivo and in vitro eukaryotic data are positive or are absent).
8	Evidence of clastogenic effects (general DNA damage, strand breaks, sister chromatid exchange), intercalations or crosslinks but no evidence of increased incidences of mutations or direct interactions with genetic material
6	Does not interact directly with DNA, but interferes with cellular mechanisms such as DNA synthesis and DNA repair. Effects may be observed at exposure levels associated with overt toxicity unrelated to genetic effects
4	Mutagen/genotoxin in prokaryotic systems only; in vitro eukaryotic data exist, and the results are negative.
2	Mutagen/genotoxin in vitro only; in vivo data exist, and the results are negative.
0	No evidence of mutagenic or genotoxic effects in a adequate battery of test systems.

Suggested Information Sources

Information on the genotoxicity/mutagenicity of chemicals would generally be obtained from original publications and review articles as identified through MEDLINE or TOXLINE databases or through the GenTox Information Service. Information may also be available from various summary data sources including Bowman (1982), Fairchild (1978), Fishbein (1979), Ketchen and Porter (1979), Kirsch-Volders (1983), Sax et al. (1981), Soderman (1983), Sontag (1981), and Stich

and San (1984). It is difficult to judge the validity of genotoxicity/mutagenicity tests from summary data, however, and original publications should be consulted where possible.

(g) CARCINOGENICITY

Rationale

This parameter describes the potential of chemicals to cause cancer. Detailed assessment of the dose-response relationships, types of cancers produced, the validity of extrapolating carcinogenicity data among species and the processes of risk identification, assessment and management are beyond the sophistication of this assessment.

There is general agreement that radiation, biological, physical and chemical agents can cause cancer. In addition, the biochemical and molecular process of cancer development, as it is understood, is similar among mammalian species (NTP, 1984; OSTP, 1985). It is evident that the development of cancer is a multi-stage process involving interactions of agents with genetic material (the genome). The induction of tumorigenic phenotypes through interactions with the genome may occur directly through the induction of somatic mutations or indirectly by alterations in gene expression. A number of factors affect the occurrence of these events, including age, sex, genetic differences, strain and species differences, diet, dose rate, route of exposure, interactions with other agents and a variety of environmental conditions (NTP, 1984; OSTP, 1985). Furthermore, the production of these effects by a chemical may be by direct action of the chemical or its metabolites (e.g., direct acting, genotoxic carcinogens) or indirect through actions of the chemical on systems that secondarily produce tumorigenic phenotypes (e.g., non-genotoxic or epigenetic mechanism). Although the detailed mechanism(s) of cancer production are not fully understood, it is evident that once the required modification in the genome occurs (known as initiation), the process is irreversible and self-propagating. A wide range of factors affect the initiation process, however, and many of these are believed to be reversible (IRLG, 1979; NTP, 1984; OSTP, 1985).

Although the exact mechanisms of the various stages of carcinogenesis are not fully understood, it is apparent that the events leading to the initiation of cells are dose-related (i.e., the frequency of occurrence of initiation increases with exposure). Once initiation has occurred, however, the subsequent development of tumours is independent of the exposure level (IRLG, 1979). This information is important to the scoring of the carcinogenic potential of a chemical.

Based on this brief summary of what is known about the process of carcinogenesis (refer to IRLG, 1979, NTP, 1984 and OSTP, 1985, for more detailed discussions), the scoring criteria for this element differentiate between direct acting and indirect acting carcinogens. It is important that the scoring system not merely reflect the completeness of the data base (e.g., only a few chemicals have been adequately studied from an epidemiological point of view in human populations to assess their carcinogeni-

city). For many chemicals, epidemiological studies to assess their carcinogenic potential will never be conducted and complete reliance will have to be placed on animal bioassay data for their evaluation. If the data from animal bioassays are viewed sufficiently strong, "epidemiologically proven" and "potential human" carcinogens (i.e., positive in animal bioassays) are given equal weight in the scoring system.

Scoring Criteria

The following definitions of carcinogenicity are used in scoring this parameter (Tomatis, 1979):

- Evidence of carcinogenicity is positive when an increase in malignant tumours is caused in more than one species or strain, in multiple experiments with varying routes or levels of exposure or to an unusual degree with respect to type, site, incidence or latency period.
- Evidence of carcinogenicity is negative when no tumour induction is observed in at least two adequate and appropriate animal studies in different species or in both animal and epidemiology studies.
- Evidence of carcinogenicity is inconclusive when neither of the above two conditions apply, usually because the observations are inadequate, of unacceptable quality or excessively limited. Contradictory results from different test systems may also lead to an inconclusive assessment. Such conditions are recorded as either positive or negative for carcinogenicity and tagged with either Q or W depending on the interpretation of the information by the scorer.

There is a great deal of controversy regarding the potency ranking of carcinogens, particularly when attempting to denote the potency of a chemical to cause cancer in man from data derived from animal cancer bioassays. Animal bioassays utilize high exposure levels (known as the Maximum Tolerated Dose or MTD protocol, see NTP, 1984; OSTP, 1985). Judgements of carcinogenic potency based on information derived from such high levels of exposure may have little relationship to potencies at lower levels of exposure comparable to those found in the environment. Consequently, the basis for potency ranking is not considered adequately developed for use in a scoring system. However, if procedures for such ranking were found reliable, they would form a reasonable basis for the scoring of the carcinogenic potential of chemicals.

Important information to assist in the interpretation of animal cancer bioassay data vis-a-vis the potential of a chemical to cause cancer in humans can be derived from assessments of its mutagenicity/genotoxicity.

The scoring scheme for this parameter is as follows:

PARAMETER SCORE	CRITERIA
10	Direct acting human carcinogen or potential human carcinogen (based on animal bioassay data) with evidence of direct interactions with genetic material. Acts as an electrophile or direct alkylating agent, produces DNA adducts, induces cell transformation, etc.
8	Indirect acting (epigenetic) human carcinogen or potential human carcinogen (based on animal bioassay data) with evidence that it does not interact with genetic material
6	Carcinogenic in animal bioassay tests at levels of exposure shown to saturate enzymes involved in the metabolism of the compound or at exposure levels shown to cause histopathological lesions known to predispose animals to the development of cancers at sites where the lesions are observed (e.g., ATPase deficient liver foci in rodents). Adequate evidence must be available demonstrating that no interactions occur with genetic material and that the chemical does not induce cell transformation.
4	positive tumorigenic agent (benign tumours) in humans or animals. Evidence must be available of a lack of interactions with genetic material. Includes chemicals that act solely as promoters and those that cause cell transformation in vitro without evidence in other systems
2	Tumorigenic in only one animal species and negative in other(s) (all studies considered inadequate)
0	Not tumorigenic in an adequate animal bioassay in at least two species and must not interact with genetic material

Information Sources

Information on the carcinogenicity of chemicals would generally be obtained from original publications and review articles as identified through IARC Monographs or MEDLINE, TOXLINE databases or National Toxicology Program (NTP) publications. Information may also be available from various summary data sources including Bowman (1982), Fairchild (1978), Fishbein (1979), Ketchen and Porter (1979), Kirsch-Volders (1983), Sax et al (1981), Soderman (1983), Sontag (1981), and Stich and San (1984). However, it is difficult to judge the validity of carcinogenicity data from summary data and original publications should be consulted.

PART 2: QUALIFYING FACTORS (i.e., TRIGGERS)

As noted before, the classification of chemicals into 3 Level-of-Concern groups consists of a three step process. The second part of this process is an initial Level-of-Concern determination by the application of qualifying factors (ie. 'triggers') to the scores, developed in the first part of the process. This Level-of-Concern determination may or may not be modified in the third (ie. Level-of-Concern Modification) part of the process.

Qualifying factors are essentially individual scores or score combinations which place the contaminant into one of three Levels-of-Concern. Level 1 is the highest Level-of-Concern. Level 3 is the lowest. Expressed in a different way, qualifying factors are various toxicological characteristics or toxicological characteristics in combination with certain environmental behaviour properties, that identify the relative hazardousness of a chemical. Chemicals, with these properties, are the ones which the CAP program intends to control by minimizing their emissions into the environment.

Tables 1 and 2 show the qualifying factors for determining Level 1 and 2, respectively. An explanation of the Tables is found below.

Qualifying factors/Level 1 (Table 1).

The table shows five columns, a general 'toxicity' column, three environmental behaviour columns (ie. 'persistence', 'bioaccumulation' & 'environmental transport') and a 'Level-of-Concern' column.

Toxicity(T) has been divided into two broad groups: 'T. except aquatic' and 'T. aquatic' which are defined in the bottom left and right hand corner of Table 1 respectively. Aquatic toxicity has been treated with lesser importance in the qualifying factors, relative to other toxicological endpoints. The assumption for this was, that before aquatic toxicity can be manifested, a contaminant emitted into the air has to disperse, be deposited into water and be built up in the water column. The contaminant must have certain environmental behaviour properties to allow for this buildup in the water column.

Scores, which are appropriate for Level 1 consideration, have also been designated as High(H), Medium(M) and Low(L) and are defined under Table 1.

There are four rows in Table 1, which outline the qualifying factors, which in turn trigger a contaminant into a Level 1 concern. These are the following:

1. Any High score in any toxicity category, except aquatic, places the contaminant in Level 1.
2. Any High score in an aquatic toxicity category along with High scores in at least two of the environmental behaviour categories (ie. persistence, bioaccumulation or environmental transport) places the contaminant in Level 1.

3. Any Medium score in any toxicity category, except aquatic, along with a High persistence score in air or a High score in bioaccumulation places a contaminant in Level 1.
4. Any Medium score in any toxicity category, except aquatic, along with a High persistence score in any of the media (ie. air, water or soil), along with a Medium or High environmental transport score to the same medium (ie. where persistence is high) places a contaminant in Level 1.

Qualifying Factors/Level 2 (Table 2)

Table 2 is laid out in a similar fashion and outlines the qualifying factors which trigger a contaminant into Level 2 concern. These are the following:

1. Any Medium or High score in an aquatic toxicity category along with any Medium or High scores in any two of the three environmental parameters(ie. persistence, bioaccumulation or environmental transport) places a contaminant in Level 2.
2. Any Medium score in any toxicity category, except aquatic, places a contaminant in Level 2.
3. Any Low score in any toxicity category, except aquatic, along with a Medium or High persistence score in air or along with a Medium or High bioaccumulation score places a contaminant in Level 2.
4. Any Low score in any toxicity category, except aquatic, along with a Medium or High persistence score in soil and along with a Medium or High environmental transport to soil score places a contaminant in Level 2.

Qualifying factors/Level 3

Any other score or score combination not covered in Tables 1 and 2, places a contaminant in Level 3.

TABLE 1
QUALIFYING FACTORS(ie. TRIGGERS) FOR
LEVEL of CONCERN

TOXICITY	PERSIS- TENCE	BIOACCU- MULATION	ENVIRON- MENTAL TRANSPORT	LEVEL OF CONCERN
Any H (T. except aq.)			→	1
Any H (T. aq.)	AND	H in ANY 2 of 3 or more	→	1
Any M (T. except aq.)	AND	H (in air)	OR	1
Any M (T. except aq.)	AND	H (any medium)	AND M or H (to same medium)	1

T.(Toxicity) except aq.(aquatic):

Teratogenicity
Genotoxicity/Mutagenicity
Carcinogenicity
Mammalian Sublethality
Non-Mammalian Sublethality(Terr. only)
Plant Sublethality(Terr. only)
Acute Lethality(Inh./Derm./Oral only)

H - HIGH Score(ie. 10)

M - MEDIUM Score(ie. 7 or 8)

L - LOW Score(ie. 4 or 6)

T.(Toxicity) aq.(aquatic):

Acute Lethality(Aquatic)
Non-Mammalian Sublethality(Aquatic)
Plant Sublethality(Aquatic)

TABLE 2
QUALIFYING FACTORS(ie. TRIGGERS) FOR
LEVEL of CONCERN

TOXICITY	PERSISTENCE	BIOACCUMULATION	ENVIRONMENTAL TRANSPORT	LEVEL OF CONCERN
Any M or H (T. aq.)	AND	Any M or H in any 2 of 3	→	2
Any M (T. exc. aq.)	—	→	2	
Any L (T. exc. aq.)	AND OR	M or H	→	2
Any L (T. exc. aq.)	AND	M or H (to soil)	→	2

T.(Toxicity) except aquatic:

H - HIGH Score(ie. 10)

Teratogenicity

M - MEDIUM Score(ie. 7 or 8)

Genotoxicity/Mutagenicity

L - LOW Score(ie. 4 or 6)

Carcinogenicity

T.(Toxicity) aquatic:

Mammalian Sublethality

Acute Lethality(Aquatic)

Non-Mammalian Sublethality(Terr. only)

Non-Mammalian Sublethality(Aquatic)

Plant Sublethality(Terr. only)

Plant Sublethality(Aquatic)

Acute Lethality(Inh./Derm./Oral only)

PART 3: MODIFYING FACTORS

Level-of-Concern classification, under the Clean Air Program, endeavours to assess the potential for the delivery of a chemical to a sensitive receptor (person, plant, animal, fish or property), in its environmental medium (air, water, soil or sediment). A purely mechanical classification system may be occasionally susceptible to error. Consequently, the Ministry reserves the right to promote or demote the ranking for certain materials, following the initial determination of level-of-concern using the toxicity scoring system. Additional compelling information and expert judgement may justify an enhanced or diminished Level-of-Concern ranking. Issues such as complex environmental interactions or transport, indirect effects, synergistic effects, or a variety of other issues all may occasionally justify the adjustment of the Level-of-Concern. These modifying factors are applied on a case-by-case basis. Some examples are provided below.

1. Promotion

Example 1. Tags (missing data), QSARs, Weight of Evidence.

Concern about the strength and availability of environmental toxicology data, in conjunction with the potential for adverse effects, may be sufficient to justify the promotion of Level-of-Concern ranking.

Example 2. Reactivity.

Some chemicals may be regulated 'at source', not because of adverse effects arising from the native chemical but perhaps because of indirect adverse effects. Indirect adverse effects may be of global importance (eg. ozone depletion and acid rain) or may arise from secondary environmental reaction products.

Example 3. Source Registration / Environmental Measurements.

Source Registration or monitoring data may provide insight into the emission and distribution of environmental contaminants. The information may indicate unforeseen large quantities of contaminants or lesser emissions, but in highly concentrated geographical areas. Both may enhance the Ministry's Level-of-Concern ranking. Emission of certain mixtures of chemicals may also be cause for promotion, in order to prevent adverse effects due to synergism.

Example 4. Assessment by other Agencies.

Some chemicals have already been assessed by other reputable agencies. Certain types of assessments are compelling and others may also be considered compelling, from time-to-time. For example, of the weight-of-evidence classifications used by the International Agency for Research on Cancer (IARC), a classification of 'Human Carcinogen' may cause the Level-of-Concern classification to be promoted.

Example 5. Other Compelling Factors.

Evidence of synergistic effects caused by the presence of multiple contaminants or significant impact of total contaminant loading, may both cause the promotion of Level-of-Concern status for key chemicals. Additional factors may need to be considered, from time to time.

2. Demotion

Example 1. Vector Scoring / Weight of Evidence.

Vector scoring has most often been designed to score high when data is missing; worst case data must be used if more reliable information is not available. Consequently, it is possible that the Level-of-Concern ranking may be overestimated, on occasion.

Example 2. Potential for Environmental Contamination.

Some chemicals may have very short half-lives in the environment and therefore will not have the opportunity to be delivered to the sensitive receptor. Providing that the chemicals resulting from the rapid environmental degradation are not themselves of concern, then the decreased concern may be reflected in the demotion of Level-of-Concern ranking.

Example 3. Other Compelling Factors.

On rare occasions, other factors may be encountered, suggesting that Level-of-Concern ranking has been over estimated. The Ministry reserves the right to demote Level-of-Concern ranking, based on expert judgement.

APPENDIX 6-3

INTERNAL MINISTRY OF THE ENVIRONMENT CHEMICAL LEVEL-OF-CONCERN CLASSIFICATION PROCESS

APPENDIX 6-3

INTERNAL MINISTRY OF THE ENVIRONMENT CHEMICAL LEVEL-OF-CONCERN CLASSIFICATION PROCESS

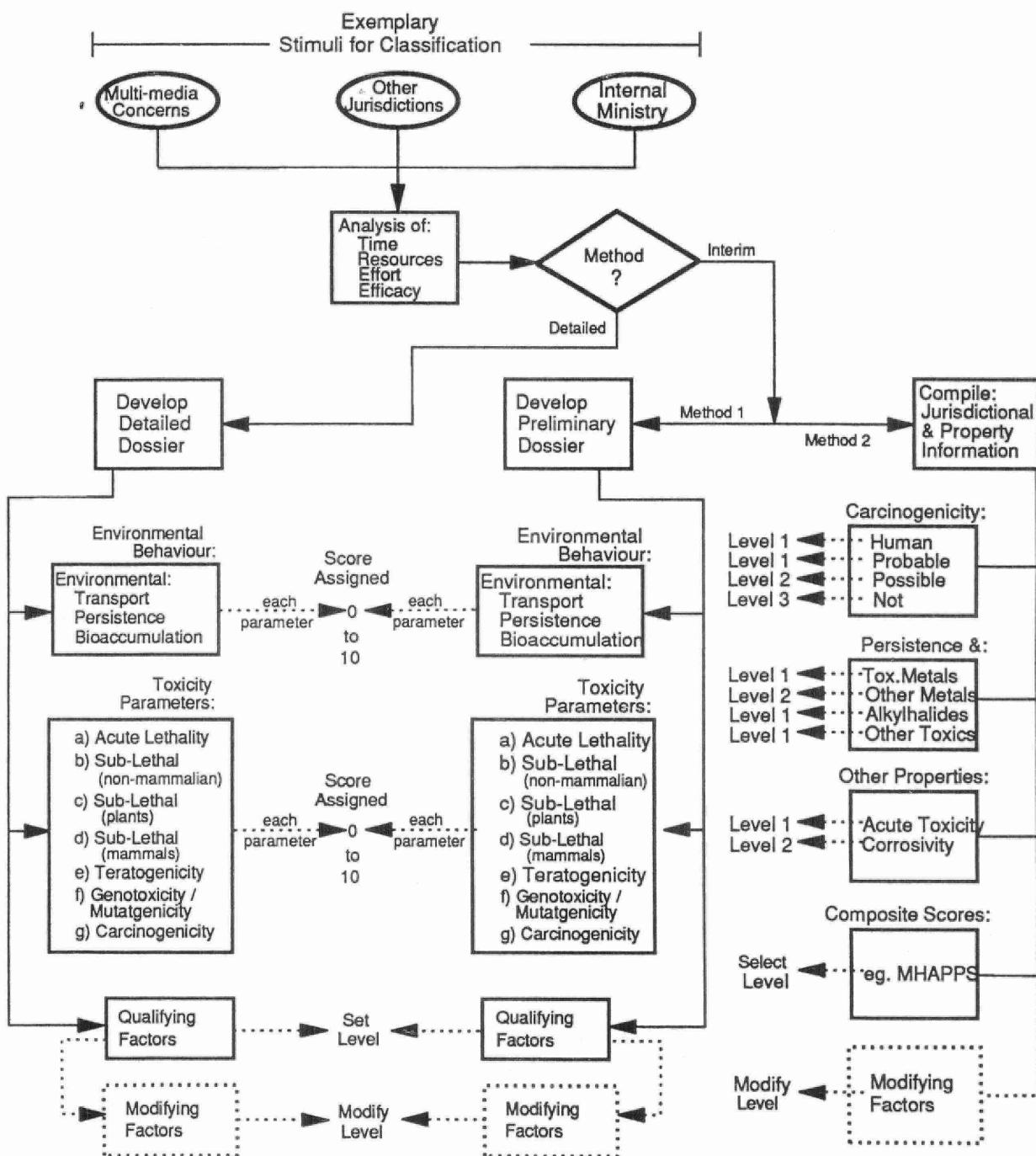
Ontario has developed three methods of chemical Level-of-Concern classification (see figure). Depending on time constraints and available resources, any of the methods or some combination of them may be used.

Besides the private sector driven stimulus for classification (see Appendix 6-5, Part 1; 'Private Sector-Driven Classification Process') there could be other stimuli for classifying chemicals. Some stimuli could come from a consideration of the priorities of other jurisdictions (e.g., CEPA, WHO, IARC, etc.) similar to the process by which the target chemical list was identified. Other stimuli could arise from any internally identified priority, like emission information from the source registration process or multi-media concerns associated with certain chemicals.

Essentially all three of the developed methods use toxicity and environmental behaviour parameters, as the basis of classification. Two of the methods are similar, differing only in the relative amount and detail of information gathered for consideration. These two methods are referred to as 'Detailed' and 'Method 1' in the figure: *Internal Ministry of the Environment Chemical Level-of-Concern Classification Process* and the corresponding data is gathered in 'Detailed' and 'Preliminary' dossiers, respectively. The methods are similar in that they both utilize the MOE scoring system (See Appendix 6-2, Part 1) previously developed and similarly applied, albeit for different purposes, in the EMPPL/MISA process. Both methods consider three environmental behaviour parameters and seven toxicity parameters as shown in the figure. Essentially, the scoring system assigns a numerical score to these parameters based on the relative level of importance of (i.e., concern about) the information that has been gathered for that parameter in the dossiers. Level-of-Concern determinations are accomplished initially, by the application of qualifying factors (i.e., 'triggers') to the scores and finally, by the application of modifying factors. Qualifying factors (see Appendix 6-2, Part 2) are various scores and score combinations used to 'trigger' the contaminant to a particular Level-of-Concern. Modifying factors (see Appendix 6-2, Part 3) represent additional compelling information and expert judgement which may justify an enhanced or diminished Level-of-Concern.

The third method, identified as 'Method 2' in the figure, uses various jurisdictional and property information which is readily available. These can include, for example, the International Agency for Research on Cancer (IARC) and/or U.S. EPA carcinogen classifications, or composite scores from the Modified Hazardous Air Pollutant Prioritization System (MHAPPS). It can also include generically inherent property information (e.g., inherent persistence of metals, as well as, those of highly halogenated organics). Appropriate qualifying factors (e.g., chemicals classified as human and probable human carcinogens would be of Level 1 concern) and modifying factors would then be applied to make a Level-of-Concern determination.

TABLE 1
Internal Ministry of the Environment
Chemical Level-of-Concern
Classification Process



APPENDIX 6-4

**LIST OF CONTAMINANTS CLASSIFIED ON
THE BASIS OF LEVEL-OF-CONCERN**

PROPOSED INTERIM LIST OF CONTAMINANTS CLASSIFIED ON THE BASIS OF LEVEL-OF-CONCERN

The Ministry of the Environment has proposed a process for classifying contaminants emitted to the air under CAP. Many of these chemicals have been listed as emissions in Certificate of Approval applications, over past years. In some instances the list also represents priority chemicals, believed to be of concern in Ontario, under the Canadian Environmental Protection Act or in other jurisdictions.

The following lists indicate the classification status of contaminants:

- Level 1
- Level 1/2 (Under review)
- Level 2
- Level 3
- Unclassified to date (ie. Level = 0)

Chemical Name	LEVEL 1	CAS #	Level
acrylonitrile		107-13-1	1
4-aminobiphenyl		92-67-1	1
arsenic		7440-38-2	1
asbestos		1332-21-4	1
benzene		71-43-2	1
benzidine		92-87-5	1
beryllium		7440-41-7	1
bis(chloromethyl)ether		542-88-1	1
cadmium		7440-43-9	1
carbon tetrachloride		56-23-5	1
chloroform		67-66-3	1
chloromethyl methyl ether		107-30-2	1
chromium		7440-47-3	1
diethylsulphate		64-67-5	1
dimethyl sulphate		77-78-1	1
dimethylcarbamoyl chloride		79-44-7	1
epichlorohydrin		106-89-8	1
ethylene dibromide		106-93-4	1
ethylene oxide		75-21-8	1
formaldehyde		50-00-0	1
hexachlorobenzene		18-74-1	1
lead		7439-92-1	1
N-methyl-N-nitrosourea		684-93-5	1
4,4'-methylenebis(2-chloroaniline)		101-14-4	1
2-naphthylamine		91-59-8	1
nickel		7440-02-0	1
nickel carbonyl		13463-39-3	1
N-nitrosodimethylamine		62-75-9	1
perchloroethylene		127-18-4	1
polychlorinated biphenyls		1336-36-3	1
polychlorinated dibenzo dioxins/furans		n/a	1
polycyclic aromatic hydrocarbons		n/a	1
propylene oxide		75-56-9	1
silica (respirable)		7631-86-9	1
styrene oxide		96-09-3	1
vinyl bromide		593-60-2	1
vinyl chloride		75-01-4	1

Chemical Name	LEVEL 1/2	CAS #	Level
acrylamide		79-06-1	1/2
aniline (benzenamine)		62-53-3	1/2
arsine		7784-42-1	1/2
bis(2-chloroethyl)ether		111-44-4	1/2
1,3-butadiene		106-99-0	1/2
chlorobenzene		108-90-7	1/2
chloromethane		74-87-3	1/2
coal tar pitch volatiles		8007-45-2	1/2
1,2-dibromo-3-chloropropane		96-12-8	1/2
3,3-dichlorobenzidine		91-94-1	1/2
1,3-dichloropropene		542-75-6	1/2
3,3'-dimethoxybenzidine		118-90-4	1/2
p-dimethylaminoazobenzene		60-11-7	1/2
1,1-dimethylhydrazine		57-14-7	1/2
1,4-dioxane		123-91-1	1/2
diphenylmethane-4,4'-diisocyanate		101-68-8	1/2
ethanol		64-17-5	1/2
2-ethoxyethanol (ethylene glycol ethyl ether; cellosolve)		110-80-5	1/2
ethylene thiourea		96-45-7	1/2
hydrazine		302-01-2	1/2
manganese		7439-96-5	1/2
methyl methacrylate		80-62-6	1/2
methylene chloride		75-09-2	1/2
2-nitropropane		79-46-9	1/2
N-nitrosomorpholine		59-89-2	1/2
particulates (inhalable, PM10)		n/a	1/2
1,3-propane sulphone		1120-71-4	1/2
1,1,2,2-tetrachloroethane		79-34-5	1/2
2,3,4,6-tetrachlorophenol		58-90-2	1/2
thiourea		62-56-6	1/2
o-toluidine		95-53-4	1/2
trichloroethylene		79-01-6	1/2
2,4,6-trichlorophenol		88-06-2	1/2

Chemical Name	LEVEL 2	CAS #	Level
acetylaldehyde		75-7-0	2
acetamide		60-35-5	2
acetic acid		64-19-7	2
acetone		67-64-1	2
acetophenone		98-68-2	2
acrolein		107-02-8	2
ammonia		7664-41-7	2
aniline (benzenamine)		62-53-3	2
o-anisidine		90-04-0	2
benzo[g,h,i]perylene		191-24-2	2
benzo[h]quinoline		230-27-3	2
benzo[k]fluoranthene		0708-9	2
calcium cyanide		592-01-8	2
calcium hydroxide		1305-62-0	2
carbon disulphide		75-15-0	2
carbon monoxide		630-08-0	2
chlorine		7782-50-5	2
chlorophenols		n/a	2
cobalt		7440-48-4	2
di-2-ethylhexyl phthalate		117-81-7	2
di-n-butylphthalate		84-74-2	2
di-n-octylphthalate		117-84-0	2
dibenzo[a,e]pyrene		192-65-0	2
dibenzo[a,h]pyrene		189-64-0	2
dibenzo[a,l]pyrene		191-30-0	2
1,4-dichlorobenzene		106-46-7	2
1,1-dichloroethylene (vinylidine chloride)		75-35-4	2
dimethyldisulphide		624-92-0	2
ethyl acrylate		140-88-5	2
ethyl benzene		100-41-4	2
ethylene		74-85-1	2
ethylene dichloride		107-06-2	2
fluorides		7664-39-3	2
hexachlorocyclopentadiene		77-47-4	2
hexamethylphosphoramide		680-31-9	2
hydrogen bromide		10035-10-6	2
hydrogen chloride		7647-01-0	2
hydrogen cyanide		74-90-6	2
hydrogen sulphide		7783-06-4	2
mercaptans		74-93-1	2
mercury		7439-97-6	2
methanol		67-56-1	2
5-methylchrysene		3697-24-3	2
methyl dianiline		107-77-9	2
mineral fibres		n/a	2
naphthaline		91-20-3	2
nitric acid		7697-37-2	2
nitrofen		1836-75-5	2
nitrogen oxides		10102-44-0	2
nitrous oxide		10024-97-2	2
octachlorodibenzo-p-dioxin		3268-87-9	2
ozone		10028-15-6	2
pentachlorobenzene		608-93-5	2

Chemical Name	LEVEL 2	CAS #	Level
pentachlorophenol		87-86-5	2
phosgene		75-44-5	2
phosphine		7803-51-2	2
phosphoric acid		7664-38-2	2
potassium cyanide		151-50-8	2
potassium hydroxide		1310-58-3	2
beta-propiolactone		57-57-8	2
radionuclides		n/a	2
selenium		7782-49-2	2
silver		7440-22-4	2
sodium cyanide		143-33-9	2
sodium hydroxide		1310-73-2	2
sulphur dioxide		7446-09-5	2
sulphuric acid		7664-93-9	2
suspended particulate matter (>10 m)		n/a	2
tetrachlorobzenes		n/a	2
tin		7440-31-6	2
o-toluidine		108-88-3	2
total reduced sulphur		n/a	2
1,1,1-trichloroethane		71-55-6	2
vanadium		7440-62-2	2
xlenes		1330-20-7	2
zinc		7440-66-6	2

Chemical Name	LEVEL 3	CAS #	Level
acetylene		74-86-2	3
benz[a]acridine		225-11-6	3
cyclohexane		110-82-7	3
dimethyl sulphide		75-18-3	3
ethylene glycol ethyl ether acetate		111-15-9	3
n-hexane		110-54-3	3
methyl bromide		74-83-9	3
methyl ethyl ketone (2-butanone)		78-93-3	3
propionic acid		79-09-4	3
1,2,4-trichlorobenzene		120-82-1	3

Chemical Name	UNCLASSIFIED	CAS #	Level
n-butyl acetate		123-86-4	0
butyl acrylate		141-32-2	0
calcium oxide		1305-78-8	0
captan		133-6-2	0
carbon black		1333-86-4	0
chlorine dioxide		10049-04-4	0
chlorophenoxy herbicides		n/a	0
diazinon		333-41-5	0
1,2-dichlorobenzene		95-50-1	0
dimethyl ether		115-10-6	0
N,N-dimethylacetamide		127-19-5	0
3,5-dimethylaniline		108-69-0	0
ethyl acetate		141-78-6	0
ethyl ether		60-29-7	0
ethylene glycol		107-21-1	0
ethylene glycol butyl ether (butyl cellosolve)		111-76-2	0
ethylene glycol butyl ether acetate		1121-71-2	0
hexachlorodibenzofurans		55684-94-1	0
hexamethylene diisocyanate monomer		822-06-0	0
hydrogen peroxide		7722-84-1	0
maleic anhydride		108-31-6	0
methyl ethyl ketone peroxide		1338-23-4	0
methyl isobutyl ketone		108-10-0	0
methyl t-butyl ether		1634-04-4	0
oleic acid		112-80-1	0
phenol		108-95-2	0
propionaldehyde		123-38-6	0
propylene dichloride		78-87-5	0
propylene glycol methyl ether		1-7-98-2	0
propylene glycol monomethyl ether acetate		108-65-6	0
sulphamic acid monoammonium salt		7773-06-0	0
2,4,5-trichlorophenol		95-95-4	0
warfarin		81-81-2	0

APPENDIX 6-5

PART 1:

PUBLIC PARTICIPATION IN THE CLASSIFICATION PROCESS

APPENDIX 6-5

PART 1: PUBLIC PARTICIPATION IN THE CLASSIFICATION PROCESS

One of two basic principles of the Clean Air Program pledges the virtual elimination of toxic emissions to the air; the other recognizes the need for a 'Responsible Stewardship', by all, over our environment. In particular, the Ministry believes that it is the responsibility of the emitter to control emissions, in accordance with the level of concern associated with such emissions, and to know the potential effects and environmental behaviour of the emitted chemicals. Consequently, many aspects of regulatory information collection for Level-of-Concern assessment will now be the responsibility of the private sector.

In the past, the largest stimulus for Ministry regulatory activity (the development of point of impingement air standards) has come from industrial sectors, usually through activities such as applications for Certificates of Approval (C of A) to Construct. Under the Clean Air Program, an additional requirement for renewable Certificates of Approval to Operate is expected to add to the existing need for Ministry analysis of the chemical hazards presented to our community and in particular a periodic review of the state of knowledge relating to those chemicals. Accordingly, it is also through these activities that proponents will now be required to submit information on the toxicological characteristics and environmental behaviour, of emitted contaminants, to the Ministry. Proponents may submit additional information to support an enhanced or diminished Level-of-Concern classification. They may also initiate 'appeals' of existing chemical Level-of-Concern classifications, through the provision of an updated dossier, optionally accompanied by additional information.

The Ministry recognizes that 'Responsible Stewardship' for our environment does not end with the business sector and that such responsibility may also be exercised by environmental groups, private citizens or partisan organizations. Therefore, these groups or individuals may also initiate the classification of chemicals or may appeal existing classifications. It is recognized that the objective of such appeals will be re-examination of the stringency of either Level-of-Concern classification or the complete regulatory strategy for individual chemicals and so would also require that group to submit or update toxicological and environmental behaviour dossiers and supplementary information, in support of their claim. The Ministry will take appropriate action on the information that it finds compelling. It is also recognized that public concern should not always need to be expressed through the provision of the extensive information required to support a Level-of-Concern classification. Therefore, an opportunity for participation has been included, where the public may trigger a Ministry examination of any chemical's classification status (ie whether information is considered current or in need of immediate review). Such a mechanism will require a low level of supporting information.

To accommodate the need for all groups and individuals to exercise 'Responsible Stewardship', the public participation/private sector-driven process of classification includes three access points: the preparation or updating of dossiers, the appeal of existing classifications and a request to update the existing classification of a chemical or chemicals. The

interrelationship of public participation/private sector and Ministry activities is shown in the attached figure.

Stimulation for Classification

Applications for Certificates of Approval have and will continue to generate the greatest need for regulatory action on specific chemicals. If a chemical does not appear on the schedule of classified chemicals (or a list of proposed updates to that schedule) or if the chemical has been identified by the Ministry as stale-dated or in need of review, then it will be necessary for a proponent to prepare or update a detailed environmental behaviour and toxicology dossier. Details of the information to be contained in this dossier are found in the guideline *Preparing a CESARS-type Dossier*. Additional information may be provided by the proponent, suggesting a Level-of-Concern classification and modifying factors that may cause the promotion or demotion of such a classification. The same process is available to any group or individual, to stimulate the possible regulation of any material, by the Ministry.

Dossiers are subject to Ministry review and if unacceptable will be returned to the proponent for revision, and re-submission. Once an acceptable dossier is submitted, then the Ministry will examine all of the information available and set an appropriate Level-of-Concern, using the procedures outlined in the 3-part section entitled *Level-of-Concern Classification*.

De novo Appeal

In those cases where a detailed CESARS-type dossier already is available, the Ministry is prepared to accept a fully updated dossier (providing complete and current information), as the basis for: the revision of a Level-of-Concern classification or the appeal of an existing classification. Such updated dossiers must be of a quality and with a content acceptable to the Ministry.

Level-of-Concern Classification

Determination of the Level-of-Concern classification is solely the responsibility of the Ministry. However, review or adjustment of the ranking, associated with a specific material, can be influenced through the provision of additional (new) information, by a proponent of such revision, only when accompanied by a CESARS-type dossier. Proponents may suggest Level-of-Concern classification and are encouraged to provide the qualifying and modifying factors that would provide a justification for any suggested classification.

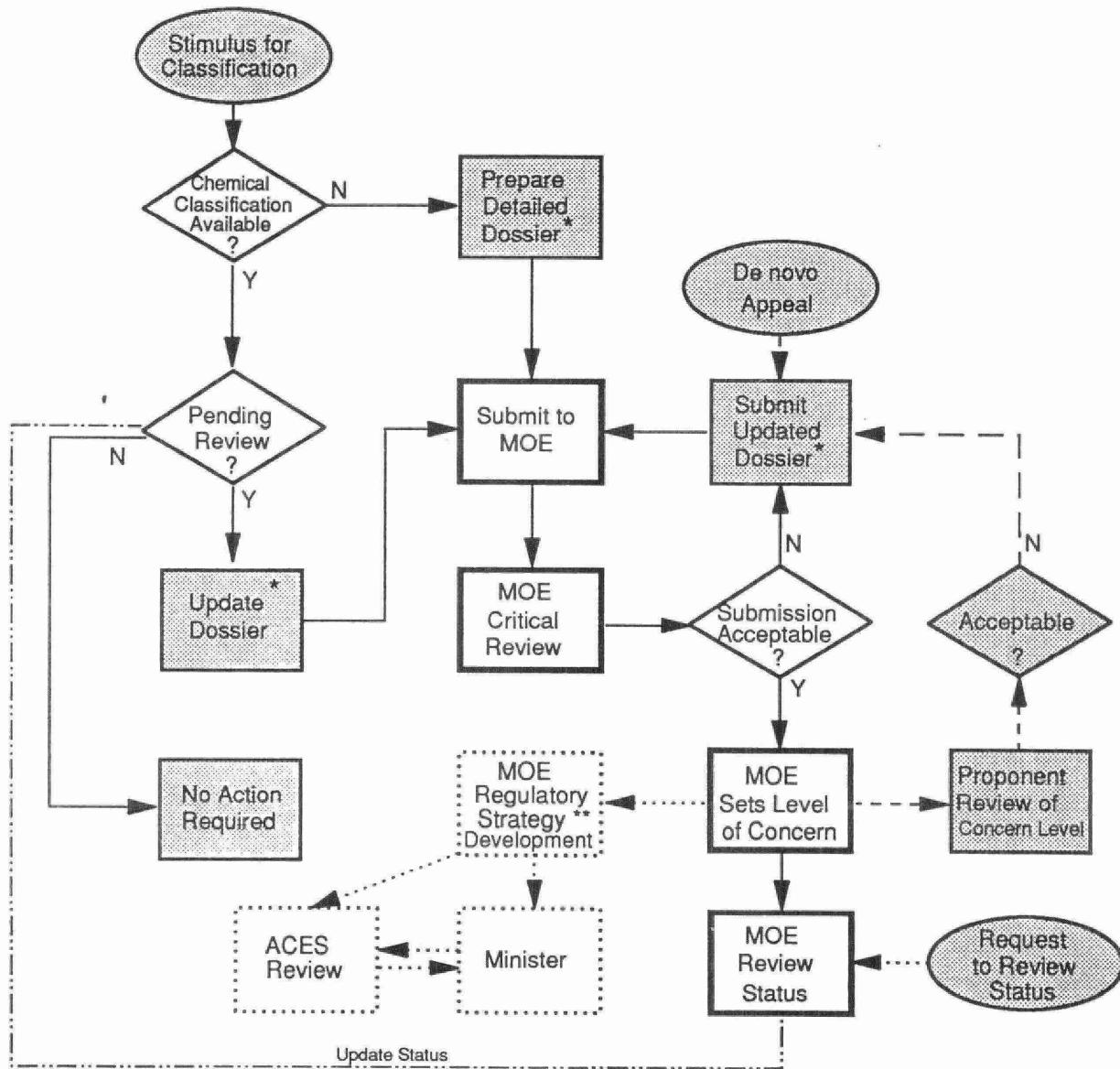
Following Level-of-Concern ranking, the Ministry will assess priorities and develop complete regulatory strategies when and as appropriate (see *Regulatory Strategies: The Decision Process*).

Review Status of Classification

The state of our scientific knowledge, about chemicals and our environment, is constantly changing and developing. Therefore, it is essential that our state-of-knowledge be periodically reviewed, on a chemical by chemical basis. Accordingly, the Ministry will, from time to time, identify the need for the review and updating of the toxicological and environmental behaviour information contained in the CESARS-type dossiers generated by industry.

Any group or individual may submit to the Ministry information supporting the need for this review. Should the Ministry find this information compelling, then that chemical will be so designated for review. Such reviews will then become the responsibility of the next C of A proponent. When this occurs the next proponent, applying for a C of A will be required to provide updated information on the chemical, to permit a review of its Level-of-Concern classification.

Public Participation in the Classification Process



APPENDIX 6-5

PART 2: CHEMICAL DOSSIERS - SUBMISSIONS BY THE PRIVATE SECTOR

The Clean Air Program has identified the need for the private sector to further exercise a commitment to responsible Stewardship' through a variety of mechanisms. One such mechanism is an awareness of toxicological and environmental behaviour of those substances that are emitted. Other mechanisms include the ability to participate in the chemical classification process through the provision of complete scientific information, suggestion of scores and qualifying factors for Level-of-Concern classification as well as additional information that may influence the Level-of-Concern classification through a consideration of modifying factors. The responsibility and opportunity for participation in the classification process is in no way limited; industry, environmental groups and the public may participate equally.

In most cases, participation in the Level-of-Concern classification process is predicated by the collection of information for presentation to the Ministry. The standard that the Ministry has chosen for the submission of information is the Chemical Evaluation Search and Retrieval System (CESARS) information dossier. For chemicals that have already been scored, a core of information may exist through the database, currently available through the Canadian Centre for Occupational Health and Safety (CCOHS) CCInfo datalink. Data collection would then consist of updating the existing information. In other cases, where such information is unavailable, the collection of all available detailed information is the responsibility of the private sector. All information provided to the Ministry will be available to the public, through the Ministry or through the CESARS database.

CESARS Dossiers: A Historical Perspective

The Ontario Ministry of the Environment has been involved in the identification and assessment of chemicals under a variety of legislation and regulations. Accordingly, for a number of years, the Ministry has been involved in the development of a vector scoring system to assist in this task. Most recently, cooperative work with the Michigan Department of Natural Resources has lead to the standardization of the content and format of this base of information.

With the advent of the Clean Air Program, the private sector will now exercise additional responsibility in the stewardship of our environment, in part, through the submission of information on the contaminants that they emit. To enable the Ministry to accurately determine the degree of hazard posed by those substances that are emitted, and to assist in the determination of safe environmental levels, the private sector will submit chemical-specific information, in the CESARS format. Information on the toxicity, metabolism, environmental fate, use, production, and existing regulations will be collected and submitted to the Ministry for assessment.

The primary function of the dossiers is to present and interpret the available data so that they can be used to evaluate the significance of current or potential exposures to a substance. The level of detail in the profiles is limited to summarizing the principal findings and conclusions of studies found on the topic areas of interest. Dossiers may be generated or assembled by the proponent or may be contracted to a qualified consultant. The content of such submissions must follow the CESARS format and can be found in the sections following and in the CESARS Manual entitled *CESARS: CHEMICAL EVALUATION SEARCH AND RETRIEVAL SYSTEM. CESARS Description and Procedures Manual*. The following sections provide some of the specifications that will aid the proponent in the development of an acceptable submission to the Ministry.

COLLECTION OF DATA FOR CESARS-TYPE DOSSIERS

The CESARS database format will be used as a benchmark for the submission of the detailed environmental information the Ministry will require, under CAP. However, CESARS will continue to be developed, with the Michigan Department of Natural Resources (MDNR). Accordingly, there may be periodic changes to the database to accommodate additional specific information that may be required as the Ministry improves the vector scoring system, described in the section *Classification of Chemicals, Part 1*. The CESARS database will provide the benchmark for both content and form of data submitted to the Ministry in detailed, chemical-specific dossiers. Each dossier, submitted by the private sector, is subject to quality assurance and quality control measures or will be returned for update. The *CESARS User Manual* provides a description of the information and format required, under CAP.

Additional information, as a supplementary package, may be provided suggesting vector scores as well as the rationale for applying particular qualifying and modifying factors to the dossier information. The section entitled *The Clean Air Program (CAP) Generic Classification Process* outlines the application of these factors.

GETTING THE JOB DONE

REQUEST FOR SERVICES: STAFF OR CONTRACTOR'S WORKPLAN

The Ministry recognizes that some proponents, in the private sector may or may not have the expertise to develop detailed (CESARS) dossiers. However, this expertise is available through the use of consultants. The following workplan specifications should aid either the proponent themselves, in the conduct of dossier development or will provide a guide to a contractor, who will act on behalf of the proponent. The following may be used as an outline in the procurement or guidance of your chemical evaluation team.

The Assignment

You are to provide state-of-the-art environmental and toxicological expertise for the preparation of dossiers on chemicals. You will provide the dossiers in sequence as they are prepared.

In particular:

6.1 TASK A

For the any chemicals emitted and not listed a updated schedule of chemicals and not identified by the Ministry for review, you will check the CAS numbers for accuracy, identify groups of chemicals or possible isomers. The exact chemical dossiers to be prepared will then be determined in consultation with the Ministry. The Crown reserves the right to make additions or substitutions (generic families or end-products) from the list of chemicals emitted.

- 6.2 For all chemicals, you will search all appropriate standard references and perform an on-line literature search on the following databases at minimum for all years the files are available, using the search strategy approved by the Ministry:

CA Search	CA Registry	Toxline
Toxlit	Aquire	Biolog
Datalog	Chemfate	TSCATS
NTIS	IRPTC	RTECS
TOXNET	TSCAPP	QSAR

Review documents are to be used as a source of references to be considered. In cases of metals, substances with large databases or groups of chemicals, the search strategy will be altered on a case by case basis in consultation with the Ministry.

- 6.3 From the results of these searches you will identify those references which should be collected and reviewed. At the request of the Ministry, you will provide for approval a copy of the search results with the relevant items marked.

6.4 **TASK B**

You will collect information for all the fields specified by the Ministry, according to CESARS standards, as described in the Michigan Department of Natural Resources, CESARS manual.

- 6.5 Except where noted otherwise, original literature, preferably in English or French will be used as the source of information. If these are not available, a search will be made for translations of the works not in English or French. Reviews from accepted world authorities can be referenced as source documents if no other information is available. If none of these are available, the abstract of a work in other languages can be cited. Except as noted, all references must indicate the original source of the information. When critical or potentially critical data is in a foreign language, the Crown may require a separate review of the material.

6.6 **TASK C**

You will review the information and provide a summary of the data presented for each topic area.

- 6.7 You will provide a factsheet which will present in language suitable for the general public the conclusions that can be drawn from the information in the dossiers as provided in the interpretative discussions and their relevance for human health and the environment. The source of the information will be given as the dossier.

6.8 **TASK D**

Optionally, you will assess the chemical according to qualifying and modifying factors proposed under the Clean Air Program and provide the rationale for the scores or Levels-of-Concern assigned. You will provide an interpretive discussion as to the significance to human health and the environment of the data presented. This discussion will cite the key studies as appropriate.

6.9 TASK E

As they are completed, you will provide in binders two (2) paper copies and one (1) electronic ASCII file of draft dossiers, draft factsheets as well as the optional Level-of-Concern scoring, qualifying and modifying factors as a summary for review by the Ministry, accompanied by a copy of the search results identifying items to be considered, a copy of all the source documents not available to the Ministry, sorted into those included in the profiles and those not. The Ministry will appoint an expert review panel to assist in the evaluation of the work, if necessary. You will then incorporate all changes requested by the Ministry.

- 6.10 Once the profiles are finalized, you will provide two (2) paper copies and two (2) electronic ASCII files, the marked draft and any other material used in preparation of the final copy. If final reports do not meet the minimal requirements as given in 6.11.1, they will be returned to the proponent for revisions.

6.11 Quality Control

6.11.1 Criteria

A final dossier will be considered complete only when it meets the following minimum criteria: No error in CAS number, synonyms, RTECS number, common name, synonyms, molecular formula. No formatting or typographical error that could lead to information being incorrectly transferred into Micro-CESARS. No error in transcription of data from the original paper to the dossier. No omission of significant data including data from additional sources cited in documents. Data is significant when it could potentially be a critical piece of data in assessing (scoring) a chemical, for any of the scoring elements; when no other information is available for a scoring element; when it substantiates available information; or when it elucidates the toxicologic, carcinogenic, teratogenic or reproductive effects of a chemical. No error in dose conversion factors. Not more than one study described in an inappropriate field. No error in reference numbers. Not more than one error in referencing per 50 references. Not more than one typographical error per page. The contractor must guarantee that the above requirements will be met.

- 6.11.2 Assurance To assure the minimum requirements above are met, the draft dossier will be reviewed by senior scientific staff, of the proponent or contractor, who will:

- compare the data in the CESARS dossier with the original paper to assure data was entered in the correct field and in the appropriate format.

- check for the accuracy of the transcription including dose conversions.
- assure that all appropriate data was transcribed as outlined in the CESARS manual and that the level of detail in the description is appropriate.
- assure that information that belongs to a different topic area or sub-topic area is also recorded.
- assure that references cited in documents that include significant toxicological information have been reviewed.
- assure that all field markers and other formatting requirements for the proper transfer of the data into the Micro-CESARS are met.
- review the topic area summaries, scoring summaries and the factsheets to assure that the data has been accurately presented and interpreted.
- assure that the information is presented in a clear concise manner. You will clearly outline in your proposal the approach to be taken for meeting the quality requirements. Each dossier, factsheet and scoring assessment will be accompanied by a letter from a recognized expert acknowledging that the information is accurate and representative of the present state of knowledge on the substance.

7.0 IF YOU REQUIRE A CONTRACTOR

If you require a contractor, you should be sure of the following Ministry requirements:

7.1 Agreement

The successful contractor must be willing to meet current Ministry requirements for content and quality control as well as submit to Ministry quality assurance measures.

7.2 Financial Control

A proponent may wish to require financial control of contracted work. The following issues may be considered (among others):

- the cost of performing the on-line search.
- the cost of collecting the information.
- the cost of compiling the information.
- the cost of preparing the summaries and factsheet.
- the cost of quality control/quality assurance.
- the cost of providing the profiles and supporting documentation.

7.3 Restrictions imposed by the Ministry.

The proposed program may be subject to alterations of some components, or to other changes. The Ministry may develop and update (from time-to-time), a list of qualified consultants.

Consultants or those collecting and assessing the information, should have supplied the following specific information, about the project:

- the strategy to be used to carry out the project;
- names of the key personnel involved including any consultations with experts, resumes for these people, their ability to interpret data and write scientific reports;
- demonstrated availability of appropriate support equipment and/or services;
- details of the Company and staff experience in carrying out similar projects;
- the 5 most relevant past assignments and names of references for those assignments.

CESARS: CHEMICAL EVALUATION SEARCH AND RETRIEVAL SYSTEM

The following attachment is a description of the CESARS system. The manual was written by the Michigan Department of Natural Resources as part of a joint effort by that state with the Province of Ontario.

CESARS: CHEMICAL EVALUATION SEARCH AND RETRIEVAL SYSTEM

CESARS Description and Procedures Manual

Prepared by:
Great Lakes and Environmental Assessment Section
Surface Water Quality Division
Michigan Department of Natural Resources
December 1987

PREFACE AND ACKNOWLEDGEMENTS

The Chemical Evaluation Search and Retrieval System (CESARS) was initially developed by the Office of Toxic Materials Control (now the Great Lakes and Environmental Assessment Section; GLEAS) of the Michigan Department of Natural Resources (MDNR). That initial effort was supported by a grant from the Environmental Protection Agency (EPA). This computerized database was previously available nationally through the EPA Chemical Information System (CIS). After EPA discontinued its support of CIS, CESARS became available through a commercial vendor, CIS, Inc. The CIS version of CESARS is available by mainframe computer on an international scale.

Most recently, the CESARS database was converted to a microcomputer version. A significant contribution toward this revision has been provided by the Hazardous Contaminants Coordination Branch of the Ontario Ministry of the Environment (MOE). This manual addresses the operation of the micro version of CESARS, and the development of chemical evaluations according to this system's capabilities and requirements. This project is part of the ongoing cooperative effort to regulate toxic chemicals in the environment by the MDNR and the MOE.

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PART I: INFORMATIONAL SOURCES

The data contained in CESARS is derived from numerous primary and secondary informational sources. These sources include reference books, journal articles, government documents, symposium proceedings, and in some cases, abstracts, corporate reports, and personal communication with researchers. The process of conducting the literature review is one of the most important steps in the overall chemical evaluation procedure. The objective of the literature search is to establish a bibliography of literature relevant to a particular chemical. This literature is then reviewed and summarized on a chemical evaluation form.

The literature search can be divided into two parts, a review of reference books and other secondary literature, and review of the various abstracting services. The secondary toxicological references and the abstracting services provide a basis for the development of a bibliography for creating a completed chemical evaluation. In some instances, the information gained from the secondary sources or the abstracts is used directly in the chemical evaluation. Examples of this are found in the "Properties" and "Manufacture" sections of the evaluation, where information from secondary sources is acceptable and meets the informational needs for that section. In other fields, the original research work is preferred, but there may be situations where the original is either not obtainable or written in a foreign language; in these cases, the information in the abstract (or secondary source) may be sufficient or of enough significance to be included in the evaluation.

PART II: PROCEDURES

A. REVIEW OF REFERENCE BOOKS AND OTHER SECONDARY LITERATURE

The Great Lakes and Environmental Assessment Section (GLEAS) has developed a library of reference materials used routinely in conducting a literature review. Currently available standard references are included in Appendix A. Appendix A1 contains the standard references that are routinely used for a Chemical Evaluation, and Appendix A2 contains additional references which may be searched according to the reviewer's discretion. The most recent available editions should be used. These lists are frequently modified as new references become available. These include reference texts such as Patty's Industrial Hygiene and Toxicology, general reference collections such as the Kirk-Othmer Encyclopedia of Chemical Technology, and government documents such as the Ambient Water Quality Criteria Documents.

The standard references in the GLEAS library serve two purposes. First, they may provide information which is directly recorded in the chemical evaluation. Secondary references may be cited for information which does not investigate the toxicity of a chemical, such as general physical properties, uses, manufacturers and synonyms. The above information may be entered in the appropriate fields i.e., synonyms, uses, etc. (see listing of field descriptions in Part III), directly citing The Condensed Chemical Dictionary, a secondary reference, as the source of the information.

Another purpose of the standard references is to serve as a bibliographic source for citations of original research work. In this case, the original work, and not the secondary reference, is pursued and directly cited when available. An example might be an entry from Dangerous Properties of Hazardous Materials (Sax, 1984). From such citations, information on the physical properties and the fire hazard of 3-hexanone may be directly listed in the proper fields. However, the toxicity data is evaluated by looking up the original citation TXAPA9 28, 313, 74, which corresponds to Toxicology and Applied Pharmacology, volume 28, starting page 313, 1974.

B. REVIEW OF ABSTRACTING SERVICES

There are numerous abstracting services which cover information in the area of chemical toxicology. Unfortunately, many of these services overlap in their coverage. GLEAS has developed a strategy for conducting this portion of the literature search process, as outlined below. It should be noted that this strategy is modified as new abstracting services and data bases become available.

On Line Data Base Searches

Review of the abstracts presented by the numerous abstracting services is facilitated by the availability of computerized databases. Many of the abstracting services have stored the information in machine-readable forms called files or databases. These databases are searched by communication between the host computer (which stores the information) and a personal computer or computer terminal via a telecommunications system using a tele-

phone and modem. The majority of these searches are performed as a series of queries and responses identified as "interactive searching". This type of searching allows immediate retrieval of the information requested, and also allows the searcher to review the information and modify the search questions if necessary to result in a more precise search.

A growing number of abstracting services and other organizations have produced computerized information files which are accessible through various database vendors. GLEAS has found that searching a few of the major chemical and environmental information databases results in a bibliography containing greater than 95% of the data necessary for writing a chemical evaluation. A complete listing of the databases currently searched in the literature review process is found in Appendix B. These databases are searched interactively for citations referring to environmental fate, terrestrial and aquatic toxicological information. Each database searched requires a unique search strategy which includes the appropriate terms needed to specify the chemical and identify the topics needed for the chemical evaluation.

In general, the chemical is either specified using its common name and appropriate synonyms or by its Chemical Abstract Service (CAS) registry number. The CAS number is a unique number for that chemical which has been assigned by the American Chemical Society and is used by some informational systems to refer to the specified chemical.

Topics are specified using appropriate technical terminology as keywords. A keyword search will typically attempt to match words used in article or book titles and indexed as descriptor terms by the database producer. Databases which contain abstracts in addition to bibliographic citations may also index words found in the abstracts as descriptor terms. These terms are also searchable as key words. In some databases, a system for categorizing and coding citations by topics has been developed by the database producer. For these databases, the producer provides a listing of all controlled vocabulary terms used in the database. As citations are included, the producer codes each citation accordingly. By reviewing the list of controlled vocabulary terms, the codes pertinent to terrestrial and aquatic toxicology are determined and may be used in subsequent searches of the database. For example, the BIOSIS database (Biological Abstracts) uses the controlled vocabulary terms (called concept codes) CC24007 for carcinogens and carcinogenesis, and CC2250\$ for toxicology. A search for studies on the carcinogenic potential of Trichloroethylene (TCE) would combine appropriate synonyms for TCE with the concept codes CC2250\$ and CC24007.

The Chemical Abstract Service is the primary abstract service used in the chemical evaluation literature review process. This service is available through CAS On-Line and several other vendors. GLEAS has found that by reviewing citations located in (or cross-referenced to) the toxicology section code for a specific chemical (using its CAS number), a large portion of the available toxicological information will be identified. In addition, a quick search of this type will indicate how much information on a relative basis may be available in other databases that are routinely searched. The CAS On-Line service contains abstracts from 1967 (Volume 66) to the present and is updated biweekly. Normally, the entire database is utilized in conducting a literature search.

Difficulties arise when chemicals have an extensive quantity of published information meeting the search criteria. Since the initial search strategy would indicate the quantity of citations found, a decision can be made at this time to limit the number of printed citations to maximize efficiency. In addition, the printed version Chemical Abstract Service is used for manual searching. For example, if a particular pesticide has an extensive amount of toxicological data available, the searcher can limit the number of printed citations to review by requesting a listing of only the more recent citations which are not yet available or indexed in printed Chemical Abstracts Service volumes. The older CAS citations can be searched manually in a cost effective manner. We have found that our on-line search strategy often does not work well for solvents and pesticides. It is difficult to distinguish between studies investigating a particular solvent and studies of other chemicals administered with that solvent as a vehicle. For a particular pesticide, it may not be possible to determine if it was the primary compound studied or if it was found as a residue or metabolite.

Printout/Abstract Review

The process of reviewing the printouts from an on-line database search or the abstracts collected as a result of a manual search is similar. It is necessary to review the citations and abstracts for information pertinent to one or more of the various chemical evaluation informational fields. Detailed discussions of the individual fields found in a CESARS evaluation and the types of information which are included in each are described in subsequent portions of this manual. Generally, it is necessary to go from the abstract to the original source of information to obtain sufficient details in order to summarize a study in the appropriate CESARS fields. However, there are times when the original citation is not available, such as when it is in an untranslated foreign journal. In such cases, the abstract may be cited directly. The abstract may also be used when summarizing studies for those fields which do not require extensive detail. In this case, the corresponding reference includes the complete original citation as well as the Chemical Abstract number or some other unique abstract identification number.

C. OVERVIEW OF FIELD FORMAT

Structure

The micro version of CESARS has been developed using Revelation software. Revelation allows for a maximum field size and/or record size of 64K bytes. Due to the potential size of an evaluation, the database has been divided into many files. Each file contains records which are made up of a group of related fields. Records for a chemical are listed by the "key" which is the CAS registry number. Together these form the evaluation. For easier and logical access by the user, files have been grouped together to form "topic areas". Files are thus also referred to in this document as "subtopics". There are presently twenty-one topic areas for data collection:

1.	PROPERTIES	11. CARCINOGENICITY
2.	REGULATIONS	12. MUTAGENICITY
3.	MANUFACTURE	13. REPRODUCTIVE.EFFECTS
4.	ACUTE.TOX.TERRESTRIAL	14. OTHER.ADVERSE.EFFECTS
5.	ACUTE.TOX.HUMAN	15. PHARMACOKINETICS
6.	ACUTE.TOX.AQUATIC	16. BIOACCUMULATION
7.	CHRONIC.TOX.TERRESTRIAL	17. TRANSPORT.PROCESSES
8.	CHRONIC.TOX.HUMAN	18. GENERAL.FATE.PROCESSES
9.	CHRONIC.TOX.AQUATIC	19. TRANSFORMATION.PROCESSES
10.	PHYTOTOXICITY	20. ANALYSIS.TREATMENT
		21. REFERENCES

Additionally, CESARS Topic Area #22 contains information on the priority ranking of chemicals of concern according to assessments by the Ontario Ministry of the Environment. That topic area will not be further discussed in this manual.

The topic areas, the subtopics that are found within them and the fields in each subtopic are outlined in Appendix C. There are approximately 400 fields in the CESARS evaluation, however, not all chemicals will have information in all the fields. When chemical evaluations are conducted, fields are "filled in" as data are found. A chemical which has very little available data would generate a short evaluation with information in only a few data fields.

Access to the CESARS evaluation is by the CAS registry number, or in cases where this number does not exist, a number may be assigned. That assigned number must be of similar format to the CAS registry number (i.e., xxxxx-xx-x) and should only be selected following a review of the master list maintained by GLEAS. If the person accessing CESARS does not know the CAS registry number, they may utilize the synonym index created in CESARS for all the synonyms listed in the file. By entering a name or part of a name, it is then possible to get a list of CAS numbers which exist in CESARS for that name. Details of that operation are available in the Micro-CESARS Database System Operations Guide.

In the case of related compounds, such as a substance with several isomers, each isomer is individually identified by a different CAS registry number and is entered in CESARS as a separate chemical record with a unique accession number. In addition, the CAS often assigns a registry number to the molecular formula for the group of isomers (i.e. not isomer specific). These general chemicals are also included in CESARS as a separate chemical record. For example, the general compound xylene (regardless of the isomeric form) has the CAS number 1330-20-7. The specific xylene isomers are identified by different CAS numbers: ortho-xylene, 95-47-6; meta-xylene, 108-38-3; and para-xylene, 106-42-3. CESARS thus contains four records on xylene, each corresponding to a different CAS number. Information contained in each record is specific to the appropriate isomer. The record for the general chemical contains information from studies from the literature in which a mixture of the isomers was used as the test chemical, or when the specific isomer used in the study was not identified. Therefore, in most cases, when searching for

complete information on a specific chemical, the records for all related compounds should also be checked. The general chemical record is also used in a third situation, usually involving evaluations on metal compounds. For most metals, the general record includes data on the metal itself and its inorganic salts. The data for the organic salts are maintained in individual and separate chemical evaluations. For example, the general class record for mercury, Class 02-1, includes data on mercury itself or its inorganic salts which include, among others, mercuric sulfate, mercuris chloride and mercurous nitrate. The organic metallic salts such as methyl mercury and mercurous gluconate are maintained as separate chemical evaluation records identified by their unique CAS numbers.

Field Types

As illustrated in the CESARS Database Directory in Appendix C, there are about 400 different data elements (fields) in CESARS. Each field is identified by a short descriptive field name called the "dictionary name". By convention, when dictionary names are stated in the text of this document, they will be capitalized and underlined for recognition. There are several types of fields used:

Key
Date
Character
Numeric
Text
Multivalue
Associated

The key field is the record identifier. In CESARS the CAS Registry Number uniquely identifies a record within each file. All files associated to the same chemical have the same key.

A date field stores a date in a specified format, 00-XXX-99: day, 3 character month abbreviation, last two digits for the year.

A character field allows entry of any alpha-numeric characters. It is used for fields where short strings of information are entered (typically less than 250 characters). This type of field can easily be searched. Although only a set number of characters are displayed by the data entry screen there is virtually no limit to the size of the field. All the information will be visible in a report.

A numeric field allows entry of a number. This type of field can easily be searched and sorted. Ranges of values can also be found. Although in the data entry screen only a set number of digits will be visible, there is virtually no limit to the size of this field. All the information will be visible in a report. The data to be entered in numeric fields will generally need to be in standardized units, which will be indicated in this manual. For these fields to be searchable it is critical that they be in the correct units and that only numeric data (including digits, decimal point and negative-sign only) appear in the fields. Exponentiation is not acceptable.

A text field is a large character field. When entering data it will invoke the Revelation text processor and thus all the data in the field is visible.

A multivalue field can be a multivalue characters (MVC) field, a multivalue numeric (MVN) field or a multivalue text (MVT) field. This allows for one field to contain many values. For example, SYNONYMS is a multivalue character field. It allows for entry of multiple synonyms without first specifying the maximum number of synonyms that will occur in any given record. For each synonym added, Revelation creates an additional synonym field in the record. Melting point (MELT.PT), boiling point (BOIL.PT) and flash point (FLASH.PT) are also multivalue character fields. The following examples illustrate the entry of data into these three MVC fields. Each data entry consists of the data followed by the reference number denoted with an R-prefix in parentheses:

Melting point (°C):

52.6	(R- 1)
52	(R- 2)
16.95	(R-24)

Boiling point (°C):

221	(R- 1)
219	(R- 2)
218	(R-23)

Flash point (°C):

112.7	(R- 1)
-------	--------

Associated fields are dependent fields, usually multivalued. They are a group of fields that belong to each other. For example, for acute fish toxicity studies, the fields for species, duration, LC₅₀, C.I., reference, test conditions, and results are associated, since to describe one study we need each of these fields. Associated fields can be either text, numeric or character. See the following example:

Acute fish toxicity:

Species	Duration (hr.)	LC ₅₀ (mg/l)	95% C.I.Reference
fathead minnow (Pimephales promelas)	24	34.3	(R-54)
fathead minnow (Pimephales promelas)	48	21.5	
fathead minnow (Pimephales promelas)	96	18.1	

Test Conditions: Flow-through test, measured concentrations. Dissolved oxygen 8.0 ppm, pH 2.4, alkalinity 16 ppm, acidity 2 ppm, hardness 20 ppm, 25°C in a static assay.
Results: reported as TLm values.

Note: Species, 95% C.I., Reference are character fields.
 Duration, LC₅₀ are numeric.
 Test Conditions and Results is a text field.

For associated fields, the first field must always contain data. Any other associated field can be left empty. However, if records which contain certain values in two associated fields need to be retrieved, data must be entered in those fields to assure proper retrieval. Searchable numeric fields may contain no more than one value to assure correct data retrieval.

In Topic Area #5: Acute Toxicity-Humans, there are only two associated multivalue fields in the first subtopic. Those fields are ACU.HMN and ACU.HMN.REF, a text and a character field designed to hold the textual data and the reference number, respectively. Two examples follow:

Study #1

Complaints reported at the TLV of 100 ppm were fatigue, sleepiness, headache and respiratory tract and eye irritation.

(R-4)

Study #2

Intolerable irritation was caused by 5000 ppm. Immediate and severe eye irritation and lacrymation with moderate nasal irritation was caused at 2000 ppm but the effects decreased in several minutes. Irritation and tearings were caused by 1000 ppm but tolerance developed rapidly. Transient eye irritation was caused at 200 ppm.

(R-42)

Abbreviations

The abbreviations used in CESARS fields are similar to those used in the Registry of Toxic Effects of Chemical Substances (RTECS) database. A complete list is given in Appendix D5. When searching for a specific study type or species, it is important to use the specified abbreviations in the search statements. Some topic areas employ a controlled vocabulary (standard list) for the assay type and species/cell type fields (e.g., mutagenicity fields of Topic Area #12). These are identified in Appendix D and/or in the individual field descriptions (Part III). Abbreviations commonly used for the terrestrial species and route fields are listed in Appendix D1 and Appendix D2, respectively. CESARS is designed such that the standardized abbreviations must be used when searching these indicated columns, i.e. searching for the word "mouse" in the species column will not retrieve any citations, however, using the abbreviation "mus" will result in numerous citations. Also, since Revelation distinguishes between upper- and lower-case letters, searching for "Mus" in that field will not be successful. All standardized vocabulary and abbreviations should be strictly adhered to.

Referencing Information Sources

All data entered into CESARS is referenced appropriately to the source except where indicated otherwise (e.g., synonyms and molecular formula are recorded without references). When a distinct reference field is present among associated fields, the reference field conforms to the format: (R-#). If a distinct reference field is not available, and the reference is required, the (R-#) must be placed after the actual data and a single space. When more than one reference reports the same data, all sources should be referenced. That may be done without repeating the data, for example: Melting point (°C):

54 (R-1)(R-7)(R-15)

Requirements for Word Processing

Data should be recorded with the following additional format to ensure accurate computerization:

Data computerization does not allow the symbols , , , or ; they should be expressed as GT, GE, LT, and LE, respectively.

Subscripts and superscripts are not transferrable by the word processor.

A space followed by "\$" will mark the end of a field.

For multivalue fields a space followed by "#" followed by a space will mark the beginning of a new value.

Data Entry Forms

The process of conducting a chemical evaluation entails the review and collection of data for the pertinent fields within each record. Examples of data entry forms which are utilized to summarize the collected information are shown in Appendix F. As the available literature is reviewed, these forms are filled in with the necessary details as described for each field description in Part III of this manual.

Topic Area Summaries

A topic area summary and the date that summary was completed are the last two fields within each of the first twenty topic areas. The purpose of the summaries is to present the information within the topic areas in a consolidated, concise and easy to understand manner. The person collecting and entering the data into a particular topic area is responsible for summarizing that data into the summary field. The summary should briefly and objectively present the results and/or conclusions drawn from the most pertinent and best quality studies. If no data are available for a particular topic area, a statement relaying that fact should be entered into the summary field. It will require professional judgment to determine the highlights and most significant information presented in the topic area, and if

a lot of data are available, relying on the best quality studies is a reasonable approach. See Appendix E for an example.

Upon completion of the chemical evaluation and entry of that evaluation into the computer, we will have the capability of lifting all the summaries from each of the topic areas and consolidating them into one, all-encompassing summary. It will only be necessary to edit the summary before finalization to insure that it reads smoothly. These chemical evaluation summaries will serve as a resource shared with a variety of interested parties who may include other departmental staff, local health agencies or concerned citizens. Although our reading audience is expected to have a college level education, many people may not have a science background and most will not be familiar with toxicology. For these reasons, technical information should be simplified and defined.

D. THE ABBREVIATED AND COMPLETE CESARS DATABASE DIRECTORIES

Appendix C of this manual includes Appendix C1, the Abbreviated CESARS Database Directory, and Appendix C2, the complete CESARS Database Directory. The complete directory includes all topic areas, subtopics, and fields currently available in the micro version of CESARS. The design of the complete CESARS will support a fairly comprehensive effort to collect and record data for a chemical. However, certain types of data have been recognized by GLEAS staff as generally being of limited usefulness to MDNR, relative to the efforts required in their collection (e.g., saltwater aquatic toxicity studies). Some other fields are designed for the recording of data by and for the Ontario Ministry of the Environment (e.g., Ontario's regulations for the chemical).

Therefore, GLEAS has developed an "Abbreviated" CESARS Database, which excludes certain data fields according to the above rationale. Appendix C1 contains the Abbreviated CESARS Database Directory. This manual addresses only those data elements found in Appendix C1. Chemical evaluations performed by GLEAS will routinely involve the collection of only those data pertaining to those fields in Appendix C1. It is recognized that the fields included in the Abbreviated CESARS Database may change over time, and that chemical evaluations performed by or for the Ontario Ministry of the Environment may follow a different protocol in this regard.

Should the reviewer find significant data belonging in a field which has not been retained in the Abbreviated version, they may still elect to record the data in CESARS. A Supplement to this manual will provide guidance for the recording of that data.

In Appendices C1 and C2, the first column is titled "Old Field #". Numbers appearing in that column pertain to the previous CESARS program, and are included here in order to help familiarize staff with the revised CESARS format. They should not be confused as being any part of the micro CESARS version.

E. QUALITY ASSURANCE PROCEDURES

After the information has been extracted from the literature and summarized onto the evaluation forms, the chemical evaluations are entered into the computer system and a printout of the C.E. is generated. At this point, the Quality Assurance Program is applied. This program consists of a three step process:

- 1) The handwritten evaluations are compared to the computerized version and reviewed for typographical errors. In particular, numbers and units are inspected since these represent a critical portion of the chemical evaluation. Any discrepancies are edited and a new printout of the evaluation, called a "route" copy, is made.
- 2) The route copy of the evaluation is assigned to a mammalian toxicologist, an aquatic biologist, and a properties/environmental fate specialist for review. In this review phase, the technical content of the evaluation is considered along with format and style. Each study is reviewed for placement into the correct fields, for clear and concise language, for proper format, and for presence of all pertinent information so that consistency is maintained throughout the entire evaluation. Any changes or modifications are noted on the route copy and are subsequently entered on the computer. Then, a final draft copy is printed.
- 3) The final draft copy of the evaluation is reviewed by an information specialist for consistency with the other evaluations in the CESAR System. This final review checks to see that all the required fields have been filled in, such as the CAS search date field, the Chemical Abstracts volumes searched fields, etc. The format is looked at closely for all fields to insure that numerical fields contain only numbers, that all data is referenced, and that the references are properly cited in Topic Area #21. A number of additional details are checked and any additions or modifications as noted on the final draft are entered into the computer system.

This Quality Assurance Program has been developed along with the Chemical Evaluation Procedures which have evolved from our experience in conducting chemical evaluations over the last twelve years. Implementation of this Quality Assurance Program has been shown to be instrumental in upgrading evaluations to the quality expected for the CESARS database.

PART III: FIELD DESCRIPTIONS

TOPIC AREA #1: PROPERTIES

Introduction. The physical and chemical properties of chemicals are recorded in the appropriate fields within this topic area. Appropriate sources of information for such data include both primary and secondary references. Appendices A1 and B list the standard references and on-line databases, respectively, that are required to be searched for each chemical evaluation. Those sources, including both primary and secondary types, are valuable references for the collection of data for this topic area. As described below, this topic area is divided into six subtopics.

Subtopic 1 contains fields for the identification of various physical/chemical properties, as described below:

Subtopic	Dictionary Name	Description
1. Properties	CAS.NO	CAS registry number
	SEARCH.DATE	CAS search date
	NAME	Common name
	SYNONYMS	Synonyms: CAS name listed first, common name listed second
	RTECS.NO	RTECS number
	MF	Molecular formula
	HAZARDS	Physical/chemical hazards
	MW	Molecular weight
	STATE	Physical state at STP
	COLOR	Color of the pure material
	ODOR	Odor of the pure material
	MELT.PT	Melting point; C
	BOIL.PT	Boiling point; C
	FLASH.PT	Flash point; C
	AUTOIGN.PT	Autoignition point; C

The following is a more detailed description of the fields in subtopic 1.

CAS.NO: Chemical Abstract Service registry number.

The Chemical Abstract Service (CAS) Registry number is a unique international identifying number for a chemical and is determined by the American Chemical Society. The format for listing a number in this field uses hyphens (i.e., xxxx-xx-x). Only one CAS number is entered into this field. The CAS number entered into this field serves as the "key field", in that it uniquely identifies the record.

Any deleted registry numbers are listed in the synonym field, SYNONYMS (see below). When a chemical has a deleted registry number, a person searching the database according to that deleted number would not find any indication that the evaluation exists for that chemical. Therefore, a "dummy record" should be created in these instances to guide the

searcher. The dummy record should include only the deleted registry number in the CAS.NO "key field", and the common name followed by the current CAS number in brackets in the NAME field. Thus, the searcher will be guided to the evaluation by being provided with the necessary CAS number for the "key field".

SEARCH.DATE: Chemical Abstract Service search date.

This field contains the date the CAS search was conducted in the most recent effort to comprehensively initiate or update the chemical evaluation. The purpose of this field is to provide the best possible estimate of how up-to-date the record is. It is recognized that the CAS search date will generally not represent the search dates for all the other on-line databases routinely searched (see Appendix B). However, the CA file is considered to be a key database for any chemical evaluation, and is routinely the first database searched. All other databases are generally searched reasonably soon after the CAS search. Therefore, the date in this field is a fair estimate of how "current" the data in the chemical evaluation is.

NAME: Common name.

This field contains the most generally accepted common name for the material.

SYNOMYS: Synonyms; with the CAS name listed first, common name listed second. This field contains additional names for the specific compound. Synonyms are listed with the CAS name listed first. The CAS name should be obtained from the American Chemical Society's Chemical Abstracts Index Guide, 9th Collective Index (or more recent CI). The "common name" in field NAME should be listed next. Some trade names are included as synonyms. Deleted CAS registry numbers (CAS numbers which have been superseded for various reasons) are also listed in this field. Informational sources for synonyms include secondary references such as the TSCA (Toxic Substances Control Act) inventory as well as primary research articles where the author has listed synonyms. References must NOT be included, in order to allow "synonym searching" capability.

RTECS.NO: RTECS number.

This field contains the identification number given to the chemical in the Registry of Toxic Effects of Chemical Substances, a quarterly publication of the U.S. Department of Health and Human Services (NIOSH).

MF: Molecular formula.

This field reports the molecular formula of the chemical given in Hill order (as used by TSCA and CAS). The number of carbons are listed first, followed by the number of hydrogens, and then the remaining elements in alphabetical order. The molecular formula is often identified in secondary reference sources and confirmed using the Chemical Abstract Service publications. The reference is not cited.

HAZARDS: Physical/chemical hazards.

This field contains a general description of the physical/chemical hazards, such as flammability, corrosiveness, etc., associated with the chemical. Informational sources for this field are usually secondary references such as Dangerous Properties of Industrial Materials (Sax, 1984).

MW: Molecular weight.

This field contains the sum of the atomic weights of all atoms shown by the empirical formula of a substance. The unitless formula weight is reported in this field. Secondary references such as the CRC Handbook of Chemistry and Physics are used as sources of information for this field.

STATE: Physical state at STP.

This field reports the physical state of the material (gaseous, liquid, or solid) at standard temperature and pressure. The physical state at nonstandard conditions would be found under OTHER.PROP, a field in subtopic 2. Secondary references such as The Merck Index are used as sources of information for this field.

COLOR: Color of the pure material.

The color of the pure material at standard temperature and pressure is reported in this field. Secondary references such as The Condensed Chemical Dictionary are used as sources of information for this field.

ODOR: Odor of the pure material.

This field reports the typical odor of the material at standard temperature and pressure. Secondary references such as The Merck Index are used as sources of information for this field.

MELT.PT: Melting point; C.

The temperature at which the solid and liquid phases of a given substance are in equilibrium is known as the melting point of the solid, or the freezing point of the liquid. This field reports the temperature in degrees Celsius at standard pressure (760 mmHg). The melting or freezing temperature at a pressure other than 760 mm Hg would be reported under OTHER.PROP, a field in subtopic 2. Standard references such as the CRC Handbook of Chemistry and Physics are used as sources of information for this field.

BOIL.PT: Boiling point; C.

This field reports the temperature in degrees Celsius at which the rate of molecular motion is sufficient to result in the escape of molecules from the surface of a liquid at standard pressure (760 mm Hg). Secondary references such as the CRC Handbook of Chemistry and Physics are used as sources of information for this field. The boiling temperature at conditions other than 760 mm Hg would be recorded under OTHER.PROP, a field in subtopic 2.

FLASH.PT: Flash point; C.

This field reports the temperature at which a liquid (or volatile solid) gives off sufficient vapor to form an ignitable mixture with air near the surface of a substance. Flash points are given in degrees Celsius. If available, the flash point test method is given. Symbols used to indicate test methods are "OC" for open cup or "CC" for closed cup. Information in this field is obtained from standard references such as the Fire Protection Guide on Hazardous Materials.

AUTOIGN.PT: Autoignition point; C.

Autoignition point of a substance, whether a solid, liquid, or gas, is the minimum temperature required to initiate or cause self-sustained combustion independently of the heating or heated element. Temperature is reported in degrees Celsius. Information for this field is obtained from secondary references such as the Fire Protection Guide on Hazardous Materials.

Subtopic 2, like subtopic 1, contains a variety of fields for the recording of physical/chemical properties. In addition, thresholds for aesthetic effects are recorded here. The fields included in subtopic 2 are as follows:

Subtopic	Dictionary Name	Description
2. Prop2	EXPLOS.LIM	Explosive limits (%)
	DENSITY	Density
	SG	Specific gravity
	HENRYS.CON	Henry's Law constant
	PKA	Acid dissociation constant
	TOD	Theoretical oxygen demand
	BOD	Biochemical oxygen demand
	COD	Chemical oxygen demand
	CONVERSION	Conversion factor
	ODOR.AIR	Odor threshold - air
	ODOR.WATER	Odor threshold - water
	TASTE.THR	Taste threshold
	OTHER.PROP	Other physical/chemical properties

The following is a more detailed description of the fields in subtopic 2.

EXPLOS.LIM: Explosive limits (%).

With respect to gases or vapors which form flammable mixtures with air or oxygen, there is a minimum concentration of vapor in air or oxygen below which propagation of flame does not occur upon contact with a source of ignition. There is also a maximum proportion of vapor or gas in air above which the propagation of flame does not occur. These two boundary lines are known as the lower and upper flammable or explosive limits and are expressed in terms of percentage by volume of gas or vapor in the air. Information is obtained from secondary references such as the Fire Protection Guide on Hazardous Materials.

DENSITY

This field reports the density as mass per unit volume (g/ml) of a compound at standard temperature unless otherwise specified. Information for this field is obtained from secondary references such as the CRC Handbook of Chemistry and Physics.

SG: Specific gravity.

The specific gravity as reported in this field denotes the ratio of the mass of a substance to the mass of an equal volume of a reference substance. The reference substance is water for solids and liquids. The temperature is specified in degrees Celsius. Information for

this field is obtained from secondary references such as The Condensed Chemical Dictionary.

HENRYS.CON: Henry's Law constant.

This field reports the weight of a gas that dissolves in a definite volume of liquid relative to the partial pressure value in the air. Values are reported in atm.m/mole. Information for this field may be obtained from the Quantitative Structure Activity Relationship (QSAR) database in Duluth, and secondary references such as the Handbook of Chemical Property Estimation Methods.

PKA: Acid dissociation constant.

The acidic dissociation constant, pKa, is the equilibrium constant established between the undissociated and dissociated components of a compound in aqueous solution under standard conditions. Information for this field may be obtained from primary references or the Quantitative Structure Activity Relationship (QSAR) database in Duluth.

TOD: Theoretical oxygen demand.

This field reports the theoretically derived total quantity of oxygen needed to completely oxidize a compound to carbon dioxide and water. The TOD is usually reported as grams oxygen per gram of compound or as milligrams oxygen per liter of sample. Secondary references such as the Handbook of Environmental Data on Organic Chemicals may be used as sources of information for this field.

BOD: Biochemical oxygen demand.

This field reports a value for the quantity of oxygen required by microorganisms to oxidize organic compounds which are present in a water sample. The standard empirical test is conducted for five days at 20°C with the oxygen consumption determined by direct measurement of the dissolved oxygen in the sample at the beginning and end of the test. Results are usually reported as milligrams of oxygen required per liter, as grams of oxygen required per liter or as grams of oxygen required per gram of compound. Deviations from the standard analysis are reported with a "Test Conditions" subheading where appropriate. Secondary references such as the Handbook of Environmental Data on Organic Chemicals may be used as sources of information for this field.

COD: Chemical oxygen demand.

This field reports a value for the quantity of oxygen required to completely oxidize both the organic and inorganic material present in water as determined by a standard test (Chemical Oxygen Demand Test). Results are generally expressed as mg O₂/l.

The chemical oxygen demand (COD) test provides a measurement of the oxygen equivalent to that portion of the organic matter in a sample which can be oxidized by a strong chemical oxidant (potassium dichromate and sulfuric acid). Although the COD test has become fairly well standardized, it is important to recognize that the analytical procedure used may greatly influence the results obtained. Where the standard method of COD test is used, the results are reported as milligrams oxygen per liter of sample or as grams of oxygen per gram of compound. Deviations from standard analytical procedures are listed with a Test Conditions subheading when appropriate. Secondary references such as the Handbook of Environmental Data on Organic Chemicals may be used as sources of information for this field.

CONVERSION: Conversion factor.

This field lists the numerical value for converting units from relative volume measurements (i.e., parts per million) in air to mass per unit volume (milligrams per cubic meter). This factor is dependent upon the density of the chemical in question. The conversion factor is reported for a temperature of 20°C and 760 mm Hg unless otherwise stated. Secondary references such as the Documentation of the Threshold Limit Values for Substances in Workroom Air are used as sources of information for this field. If a value is not reported in the literature, it can be derived from a table in Volume IIc of Patty's Industrial Hygiene and Toxicology, 3rd Ed.

ODOR.AIR: Odor threshold-air.

This field reports values for the lowest concentration at which a chemical in air is detectable by the sense of smell. No standard methods are established for performing this test and ambient conditions may greatly affect the results. Secondary references such as the Handbook of Environmental Data on Organic Chemicals may be used as sources of information for this field. A useful literature review for this type of data is "Odor as an Aid to Chemical Safety: Odor Thresholds Compared with Threshold Limit Values and Volatilities for 214 Industrial Chemicals in Air and Water Dilution", by Amoore and Hautala, 1983, Journal of Applied Toxicology 3(6).

ODOR.WATER: Odor threshold-water.

This field reports values for the odor threshold, defined as the lowest concentration of a chemical in water that is detectable by the sense of smell. No standard methods are established for performing this test and ambient conditions may greatly affect the results. Secondary references such as the Handbook of Environmental Data on Organic Chemicals may be used as sources of information for this field. The above review by Amoore and Hautala is also useful.

TASTE.THR: Taste threshold.

This field reports the lowest concentration at which the taste of a chemical is detectable. The taste threshold may be identified in the water directly or in fish or shellfish inhabiting the water. No standard methods are established for performing this test and ambient conditions may greatly affect the results. Studies included in this field are described briefly to indicate the test method and the taste threshold value. When available, additional details are included in a narrative discussion in Topic Area #14: Other Adverse Effects. In addition to primary references, secondary references such as the Handbook of Environmental Data on Organic Chemicals or Impairment of the Flavor of Fish by Water Pollutants (EPA-R3-73-010) may be used as sources of information for this field.

OTHER.PROP: Other physical/chemical properties.

This field contains a collection of physical and chemical properties of a chemical that are not listed in the previously defined fields. Some examples are vapor density, pH, adsorption coefficient and parachor. Various properties that are determined under nonstandard conditions are also listed here.

Subtopic 3 contains information on aqueous solubility. This subtopic contains several associated fields designed for the recording of several study parameters in a tabular format. This subtopic also contains a separate field for the description of studies utilizing other solvents. The fields and their descriptions follow:

Subtopic	Dictionary Name	Description
3. Prop.sol	SOL.WATER.LOW	Solubility (mg/l); lower value of range
	SOL.WATER.HIGH	Solubility (mg/l); higher value of range
	SOL.TEMP	Temperature; °C
	SOL.TYPE	Measured or estimated value
	SOL.METHOD	Method used
	SOL.REF	Reference
	SOL.TEXT	Discussion
	SOL.OTHER	Solubility; other solvents

This subtopic reports the aqueous solubility of a given solute, defined as the quantity of that solute which dissolves in a specified quantity of water to produce a saturated solution at a specified temperature. In this field, the solubility is reported in mg/l and the temperature is given in degrees Celsius. There are two fields for the solubility value: a lower and a higher value of a range. These will accommodate data reporting a range. If a reference reports a single value, it should be recorded in both fields (low and high). When available, it is noted under SOL.TYPE whether the solubility value was determined by direct measurement and noted as "m" or by using estimating techniques and noted as "e". A short description of the methodology is included when available under SOL.METHOD. Information for this subtopic may be obtained from secondary references such as the Handbook of Environmental Data On Organic Chemicals, as well as from primary references.

Among the associated fields comprising the tabular format, the first three fields are designed to be numerically searchable with columns to list solubility values (low and high) and the temperature. The next two fields are designed to be "character searchable" with columns to identify the measured (noted as "m") or the estimated (noted as "e") methodology, and a description of the method. The last column holds the reference number denoted with an R-prefix in parentheses. Finally, the textual field (SOL.TEXT) contains any additional discussion that is available and considered relevant.

Data in the SOL.OTHER field reports the solubility of the chemical as a solute in solvents other than water at various temperatures, or solubility of a solute in water when reported in units other than mg/l. This is a textual field. Information for this field may be obtained from secondary references such as The Merck Index and the Kirk-Othmer Encyclopedia of Chemical Technology, as well as from primary references.

Subtopic 4 contains information on the vapor pressure. This subtopic consists of several associated fields, designed for the recording of several study parameters in a tabular format. The fields and their descriptions follow:

Subtopic	Dictionary Name	Description
4. Prop.VP	VP.LOW	Vapor pressure (mmHg); lower value of range
	VP.HIGH	Vapor pressure (mmHg); higher value of range
	VP.TEMP	Temperature; C
	VP.TYPE	Measured or estimated value
	VP.METHOD	Method used
	VP.REF	Reference
	VP.TEXT	Discussion

Data reporting the pressure exerted by the vapor at equilibrium with the liquid, at a given temperature, are recorded in this subtopic. Standard units are mmHg or Torr for VP, and C for temperature. There are two fields for vapor pressure value: a lower and a higher value of a range. This will accommodate a reference reporting a range. If a single value is reported in a reference, it should be listed in both fields (low and high). When available, it is noted under VP.TYPE whether the vapor pressure was determined by direct measurement and noted as "m" or by using estimating techniques and thus noted as "e". A short description of the methodology is included when available under VP.METHOD. The first three fields are designed to be numerically searchable, while the remaining fields may be searched by character. The reference number is denoted with an R-prefix in parentheses under the field VP.REF. Finally, the textual field (VP.TEXT) contains any additional discussion that is available and considered relevant.

Information for this subtopic can be obtained from secondary references such as the Handbook of Environmental Data on Organic Chemicals, as well as from primary references.

Subtopic 5 contains information on the n-octanol/water partition coefficient. This subtopic consists of several associated fields, arranged in a tabular format, for the recording of several study parameters. The fields and their descriptions follow:

Subtopic	Dictionary Name	Description
5.Prop.Kow	KOW.LOG.LOW	Log Kow; lower value of range
	KOW.LOG.HIGH	Log Kow; higher value of range
	KOW.TYPE	Measured or estimated value
	KOW.METHOD	Method used
	KOW.REF	Reference
	KOW.TEXT	Discussion

The ratio between the equilibrium concentrations of a given solute in the n-octanol and water fractions of a biphasic test vessel is referred to as the partition coefficient. The

partition coefficient is measured in the laboratory by quantitative analysis of the chemical solute concentrations in the n-octanol phase and in the water phase.

It is also possible to estimate the ratio using empirically derived relationships based on structural fragments of the chemical molecule of interest. The published methods of Hansch and Leo are commonly used to estimate a Kow value. The partition coefficient is recorded in CESARS as the base 10 logarithm of the n-octanol/water concentration (Log Kow). Any data reported as Kow should be converted to Log Kow by the reviewer, and stated as such in the textual field. All values reported are referenced as to source and a brief description of the determination procedures or author's method is presented if available. Partition coefficients may be calculated or measured directly and are labelled as such within the data base. Secondary references such as Substituent Constants for Correlation Analysis in Chemistry and Biology or updated computer versions of the QSAR data base system may be used as sources of information for this field.

There are two fields for the Log Kow value: KOW.LOG.LOW and KOW.LOG.HIGH. These will accommodate data reporting a range. If a single value is reported, it should be entered in both fields. Under KOW.TYPE, it is noted whether the octanol/water partition coefficient was determined by direct measurement and noted as "m" or by using estimating techniques and noted as "e". A description of the method used is included under KOW.METHOD. The reference number is denoted with an R-prefix in parentheses in the field KOW.REF. KOW.TEXT contains any additional discussion that is available and considered relevant.

The first two fields are designed to be numerically searchable as the Log Kow value, or range of values, reported. The remaining fields in this subtopic may be searched by character.

Subtopic 6 contains a summarization of this topic area, as discussed in Part II.C of this manual, in field PROP.SUM. The date of the most recent revision to this summary is recorded in field PROP.DATE.

TOPIC AREA #3: MANUFACTURE

Subtopic 1 of this topic area is for the recording of data on the use and manufacture of chemicals. The fields in this subtopic include:

DICTIONARY NAME DESCRIPTION

USES	Common uses of the chemical
PRD.MANUF	Manufacturer name (U.S.)
PRD.LOCAT	Location of manufacturer (U.S.)
PRD.YEAR	Year of manufacture (U.S.)
PRD.QTY	Quantity of production (U.S.)
PRD.REF	Reference (U.S.)

Common and recommended uses are listed in the field USES for the chemical, both as it is used by industry and as a consumer product. Also, if a chemical has no known use (e.g., dioxins), it may be indicated in this field if the substance is an impurity of another product or appears in a waste stream of certain processes. Secondary references such as The Condensed Chemical Dictionary may be used as sources of information for this field. Following the uses cited from each reference, the reference number should be given.

Data on the production of the chemical is organized in a tabular section including the fields PRD.MANUF, PRD.LOCAT, PRD.YEAR, PRD.QTY, and PRD.REF. These associated fields contain the information on the manufacturers' name, location, year, quantity and reference used, respectively. The major U.S. producers, their production sites and production volumes in a given year are listed when available. If a reference provides historical production data with a note (e.g., that it is no longer produced), that notation may be included in field PRD.QTY. Secondary references such as the Kirk-Othmer Encyclopedia of Chemical Technology, and Synthetic Organic Chemicals by the U.S. International Trade Commission may be used as sources of information. The computerized TSCAPP file (Toxic Substances Control Act Plant and Production data), available on CIS, may be useful.

Subtopic 4 contains a summarization of this topic area, as discussed in Part II.C of this manual, in field MANUF.SUM. The date of the most recent revision to this summary is recorded in field MANUF.DATE.

TOPIC AREA #4: ACUTE TOXICITY - TERRESTRIAL LIFE

Information on the acute toxicity of chemicals to terrestrial life (excluding humans) is included in this topic area. Acute toxicity refers to adverse effects elicited by test compounds after a single exposure or multiple doses within 24 hours. The following is a list of the subtopics, fields (by dictionary name), and field descriptions included in this topic area:

	SUBTOPIC	DICTIONARY NAME	DESCRIPTION
1.	Acu.orl		Acute oral toxicity
	ACU.ORL.SP	Species tested	
	ACU.ORL.LOW	LD50 (mg/kg); Lower value of range	
	ACU.ORL.HIGH	LD50 (mg/kg); Higher value of range	
	ACU.ORL.REF	Reference	
	ACU.ORL.TEXT	Test conditions and results	
2.	Acu.der		Acute dermal toxicity
	ACU.DER.SP	Species tested	
	ACU.DER.LOW	LD50 (mg/kg); Lower value of range	
	ACU.DER.HIGH	LD50 (mg/kg); Higher value of range	
	ACU.DER.REF	Reference	
	ACU.DER.TEXT	Test conditions and results	
3.	Acu.ihl		Acute inhalation toxicity
	ACU.IHL.SP	Species tested	
	ACU.IHL.LOW	LC50 (mg/m); Lower value of range	
	ACU.IHL.HIGH	LC50 (mg/m); Higher value of range	
	ACU.IHL.DUR	Duration (hours)	
	ACU.IHL.REF	Reference	
	ACU.IHL.TEXT	Test conditions and results	
4.	Acu.oth.ter	ACU.OTHER	Acute toxicity; other studies
	ACU.OTH.REF	Reference	
5.	Acu.ter.sum	ACU.TER.SUM	Topic area summary
	ACU.TER.DATE	Summary date	

The median lethal dose (LD50) is the dose of a substance that can be expected (statistically) to be lethal to 50% of animals exposed. The LD50 is applicable to exposures via the oral and dermal routes as well as injection. The median lethal concentration (LC50) is the concentration of a substance that can be expected (statistically) to be lethal to 50% of the exposed animals after a specified duration of exposure. In this topic area the LC50 applies only to exposures via inhalation, although the term LC50 is also used in reference to aquatic organisms and exposure via ambient water.

Subtopics 1-3 contain data on oral, dermal, and inhalation routes, and are organized similarly. They each contain a tabular section (for species, LD50 (LC50), and reference data) followed by an associated text field. The tabular section for inhalation data has an additional field for the duration of exposure. The numeric information is searchable by computer, therefore only one value can appear in each field, per line. If a study provides data for multiple species, median lethal doses, or durations, multiple lines of tabular data may be entered, followed by a comprehensive textual section.

As indicated in the above table which lists the fields and brief field descriptions, the dose must be in standardized units. For oral and dermal data, dose must be in mg/kg. For inhalation studies, dose must be in units of mg/m with the duration in hours. This convention will allow the data to be searchable. The above table also indicates that each subtopic has two distinct fields for dose: a "lower" and a "higher" value of a range. These refer to occasions when a study will report an apparent range for the median lethal concentration, e.g., 5-10 mg/kg. The CESARS format, with "low" and "high" fields, allows these data to be entered on computer while retaining searchability. This "range" does NOT refer to confidence limits, or to reports of interspecies variation. Generally, LD50 (or LC50) will be reported as a single value; the reviewer should then enter that value in BOTH the "low" and "high" fields.

The fields ACU.ORL.TEXT, ACU.DER.TEXT, and ACU.IHL.TEXT hold textual descriptions of the data in the respective subtopics. These fields contain sections for test conditions and results. The parameters included in the test conditions, when available, are 1) the strain, age, sex and mean body weight of the test animals, 2) the vehicle used in the administration of the test compound, 3) the method of administration (i.e., by gavage or via diet), 4) the number and range of dose levels used, 5) the number of animals used per exposure concentration, and 6) the length of observation period. When any of these parameters are unspecified, it is mentioned that no further details are given for the test conditions. For dermal studies, additional parameters which may be recorded include the duration of exposure, whether the application site was patched or left uncovered, whether the compound is applied to clipped or shaved skin, and whether the skin is intact or abraded. Additional test conditions for inhalation studies include the chemical's physical form (gas, vapor, aerosol, dust or mist), and particle size and distribution. The results section includes, when available, the 95% confidence limits and the method of calculation of the median lethal dose, the necropsy observations, the histopathologic findings and other toxic effects mentioned by the author. If the dose must be converted to standard units, the reported dose should be mentioned in this section, along with the method of conversion.

Subtopic 4 contains the fields ACU.OTHER and ACU.OTH.REF. ACU.OTHER is a text field for the summarization of acute toxic effects for non-human terrestrial life other than oral, dermal, and inhalation LD50/LC50 studies. These include LD50s derived from other routes of exposure (e.g., subcutaneous, intravenous, intraperitoneal, or intramuscular). Studies elucidating target organs and histopathologic examinations after acute exposure to a chemical would also be reported here. Information derived from skin and eye irritation tests, and dermal contact sensitization studies are reported in this subtopic also. Since

there is a variety of test types which are reported in this subtopic, the textual description for each data entry should begin with the identification of the main objective of the study. The information recorded is dependent on the study type. Generally, those parameters used for discerning adverse effects (e.g., enzyme levels, organ function tests, behavioral changes) are reported, in the context of the dose-response. When evaluating primary eye (i.e., the Draize test) and skin irritation tests, the grade level of the resulting irritant/corrosive effect with a brief description of the grade level is reported. Each summary is followed by a reference number denoted with an R-prefix in parentheses in field ACU.OTH.REF.

Subtopic 5 contains a summarization of this topic area, as discussed in Part II.C of this manual, in field ACU.TER.SUM. The date of the most recent revision to that field is recorded in field ACU.TER.DATE.

TOPIC AREA #5: ACUTE TOXICITY-HUMANS

Subtopic 1 contains acute human exposure information in a narrative format. Acute toxicity refers to adverse effects elicited by test compounds after a single exposure or multiple doses within 24 hours. ACU.HMN is a text field for the recording of such data, followed by the reference number denoted by an R- prefix in parentheses in field ACU.HMN.REF.

The content in field ACU.HMN should adequately describe the exposure situation by including details such as the concentration, route and duration of exposure whenever possible. Symptoms, physiological effects, behavioral effects, dose-response, and information on target organs among exposed individuals should also be noted.

The most desirable sources of such information are generalized discussions, as found in secondary references and reviews, which provide the details described above. Primary references, reporting case studies, suicide attempts, or accidental exposures involving only a few individuals, need not be recorded if adequate generalized discussions are available. If only primary references are available, those that most adequately provide the above information should be recorded.

Subtopic 2 contains a summarization of this topic area, as discussed in Part II.C of this manual, in field ACU.HMN.SUM. The date of the most recent revision to this summary is recorded in field ACU.HMN.DATE.

TOPIC AREA #6: ACUTE TOXICITY-AQUATIC

This topic area contains information about acute toxicity studies for freshwater aquatic species. Reported here are the median lethal concentrations (LC50) or median effect concentrations (EC50) for fish and aquatic macroinvertebrates. Information is collected from such studies and placed in the appropriate fields, as presented below:

Subtopic	Dictionary Name	Description
1. Acu.fish	ACU.FISH.SP	Acute fish toxicity Species tested
	ACU.FISH.DUR	Duration (hours)
	ACU.FISH.LC	LC50/EC50 (mg/l)
	ACU.FISH.CI	95% Confidence interval (mg/l)
	ACU.FISH.REF	Reference
	ACU.FISH.TEXT	Test conditions and results
Subtopic	Dictionary Name	Description
2. Acu.inv	ACU.INV.SP	Acute macroinvertebrate toxicity Species tested
	ACU.INV.DUR	Duration (hours)
	ACU.INV.EC	EC50 (mg/l)
	ACU.INV.CI	95% Confidence interval (mg/l)
	ACU.INV.REF	Reference
	ACU.INV.TEXT	Test conditions and results
7. Acu.aq.sum	ACU.AQ.SUM	Topic area summary
	ACU.AQ.DATE	Summary date

Subtopics 1 and 2 contain information from acute toxicity studies on freshwater fish and macroinvertebrates, respectively. These subtopics contain both a tabular and a textual section. The tabular section consists of fields for the species name (common and scientific); test duration, LC50 or EC50 concentration; 95% confidence interval for the LC50 or EC50, and the reference number of the study denoted with an R-prefix in parentheses. The textual section contains pertinent information about the test conditions and results. The types of studies included in these subtopics are generally 1- to 7-day acute lethality tests using continuous flow exposure or static exposure. The test concentrations can be either measured or unmeasured (nominal).

Acute toxicity studies which are included in subtopics 1 and 2, as a general rule, meet the following criteria:

1. Include acute toxicity tests which have been conducted using acceptable test procedures (i.e., ASTM E-729 or similar procedures).
*
2. Data from tests in which no control treatment existed, tests in which too many organisms in the control died or showed signs of stress or disease, should not be included.

3. Tests in which distilled or deionized water was used as the dilution water without the addition of appropriate salts should not be included.
4. Acute tests in which the embryo stage lasted for more than half the duration of the test should not be included.
5. Results of acute tests conducted in unusual dilution water, e.g., dilution water containing high levels of total organic carbon or particulate matter (higher than 20 mg/l) are not included, unless there is a relationship between toxicity and organic carbon or particulate matter or unless data show that organic carbon, particulate matter, etc., do not affect toxicity.
6. Include test results which are reported as an EC50 when based upon the combined total percentage of: (1) organisms immobilized, (2) organisms exhibiting loss of equilibrium, (3) animals killed. The results are reported as a LC50 when based upon percentage of organisms killed.

The numeric fields in the tabular sections are intended to be searchable by computer. Units are standardized, as indicated. Exponentiation is not acceptable. To allow searchability, only one value can occur in each field, per line. Several lines of tabular data may be used to describe studies with multiple species, durations, or LC50/EC50 values. Following those multiple tabular lines, a single textual section may then address the test conditions and results for each.

Subtopic 7 contains a summarization of this topic area, as discussed in Part II.C of this manual, in field ACU.AQ.SUM. The date of the most recent revision to this summary is recorded in field ACU.AQ.DATE.

Topic Areas #7 and #8 report information from subchronic and chronic toxicity studies. Topic Area #7 includes terrestrial animal studies while Topic Area #8 deals exclusively with human data. If available, the No-Observed-Adverse-Effect Levels (NOAELs) are reported in Topic Area #7, subtopic 3 for the terrestrial animal studies and Topic Area #8, subtopic 2 for human studies.

Subchronic and chronic toxicity studies are conducted to determine the adverse effects which may result following repeated administration of a particular compound over a portion of the entire lifetime of a test animal. Although some researchers distinguish between subacute and subchronic exposure studies the terms are used synonymously on this text. The exposure duration for a subchronic study may range from two to 90 days or approximately 10% of an animal's lifetime. A chronic or long-term study is that which approximates the full lifetime or a significant portion of an animal's lifetime. The subchronic/chronic topic areas are divided into a searchable tabular area and a textual section which consists of the test conditions and results.

There is a potential for toxicity information in these topic areas to overlap with that in topic areas for carcinogenicity and reproductive effects. Generally, information related to tumor pathology or reproductive/developmental effects are only briefly cited in the subchronic/chronic sections and are reported in detail in the appropriate topic areas.

TOPIC AREA #7: CHRONIC TOXICITY: TERRESTRIAL LIFE

Subtopic 2 contains the following fields, supplying information from animal studies which have been conducted to investigate the subchronic/ chronic effects of an environmental toxicant.

Dictionary Name	Description
CHR.TER.SP.	Species Tested
CHR.TER.ROUTE	Route of exposure
CHR.TER.DOSE	Dose (mg/kg/d)
CHR.TER.SCH	Dosing schedule
CHR.TER.REF	Reference
CHR.TER.TEXT	Test conditions and results

These associated fields are organized in a tabular format in CESARS, with the species, route, and dose fields designed to be searchable. The fields for species, route, dose, dosing schedule, and corresponding reference number denoted with an R-prefix in parentheses are arranged in a columnar format and contain only one value per line. Abbreviations used in the species and route fields are identified in Appendices D1 and D2, respectively. These standardized abbreviations must be strictly adhered to, including the use of lowercase letters only. The administered dose is to be listed in standard units of mg/kg/d for all routes of administration. In this situation mg/kg/d is the actual administered daily dose. It is not a time-weighted-average or a study-average dose, unless the author has reported it that way. If the reported dose was converted to standard units by the reviewer, method of conversion used and assumptions made are described in "test conditions" (see below), and the dose as

reported by the author is included in the "dosing schedule" field. Following the tabular section is an associated text field, CHR.TER.TEXT, which is comprised of a narrative of test conditions and results. This textual field may address one or more lines of tabular data. Since species, route, and dose are searchable and can have only one value per line, several lines of tabular information are often necessary due to multiple species, dosing or routes. If multiple lines of tabular information are used for a single study entry, the species, route, and dose fields must be filled in for each line. Dosing schedule needs to be filled in for each additional line only if the schedule changes from that described on the previous line. However, complex studies utilizing multiple species, routes, doses or schedules, may be better summarized for clarity by dividing them into separate data entries with their own distinct textual fields.

The text field CHR.TER.TEXT contains a summarization of the study test conditions and results. The information listed in the test conditions section includes, when available, the strain, sex, animal numbers, initial age and weight of the animals, final weights, information on any vehicle used, details on any controls used, details on study schedule and the clinical, behavioral and/or histological parameters evaluated. If the list of parameters evaluated is extremely long, a general descriptive statement may be preferable. If the reported dose was converted to standard units (mg/kg/d) by the reviewer, method used and assumptions made for the conversion are described in this section. Statistical methods used to detect any significant differences are also reported if available. The results section reports any significant differences observed in the experimental group(s) as related to the control group(s). Dose-related trends are also reported if the information is available. The author's final conclusions for the study, as well as any additional variables which could complicate the conclusions or compromise the study's adequacy, are also included in the results.

Subtopic 3 contains a listing of all reported No-Observed-Adverse-Effect Levels (NOAELs) for subchronic/chronic studies with non-human terrestrial species. NOAELs are determined by study author(s), or alternatively, are discerned by Staff based on the information provided. A NOAEL determination is made by the reviewer only if the study provides sufficient information. From appropriate studies three pieces of information are reported in three distinct, searchable fields in subtopic 3: species, NOAEL, and reference. The NOAEL is reported in standard units of mg/kg/d.

Subtopic 4 contains a summarization of this topic area, as discussed in Part II.C of this manual, in field CHR.TER.SUM. The date of the most recent revision to that field is recorded in field CHR.TER.DATE.

TOPIC AREA #8: CHRONIC TOXICITY - HUMAN

Subtopic 1. contains several associated fields which summarize studies investigating human subchronic/chronic exposure to a chemical. These fields are:

Dictionary Name	Description
CHR.HMN.ROUTE	Route
CHR.HMN.DOSE	Dose (units may vary)
CHR.HMN.SCH	Dosing schedule
CHR.HMN.REF	Reference (R-#)
CHR.HMN.TEXT	Test conditions and results

The fields for route, dose, dosing schedule, and corresponding reference number denoted with an R-prefix in parentheses are associated fields, arranged in a tabular format and containing only one value per line. Abbreviations used in the route field are identified in Appendix D2. The dose may be listed in the units as reported in the study. Following the tabular section is an associated text field, CHR.HMN.TEXT, which includes a narrative of test conditions and results. This textual field may address one or more lines of tabular data. Several lines of tabular information are often necessary due to multiple routes, dose levels or schedules. If multiple lines of tabular information are used for a single study entry, the route and dose fields must be filled in for each line. Dosing schedule does not need to be filled in for each line unless the schedule changes. However, complex studies with multiple routes, doses or schedules may be summarized more clearly by dividing them into separate study entries with their own distinct textual fields.

CHR.HMN.TEXT is a text field which summarizes the study test conditions and results. The information listed in the test conditions section includes, when available, the sex, age, race and weight of the humans evaluated, details on control group(s), details on exposure schedule, and the parameters evaluated. Statistical methods used to detect any significant differences are also reported if available. The results section reports any significant differences observed in the study groups relative to control group(s). Dose-related trends are also reported if the information is available. The author's final conclusions for the study, as well as any additional variables which could complicate the conclusions or compromise the study's adequacy are included in the results.

Subtopic 2 contains a listing of all reported No-Observed-Adverse-Effect Levels (NOAELs) for humans that are provided by the study author(s) or that the reviewer may discern from subchronic/chronic studies. A NOAEL determination is made by the reviewer only if the study provides sufficient information. From appropriate studies, two pieces of information are reported in distinct, searchable fields in subtopic 2: the NOAEL and the (R-#) in fields CHR.HMN.NOAEL and CHR.HMN.NOAEL.REF, respectively. The NOAEL is reported in the units given in the study.

Subtopic 3 contains a summarization of this topic area, as discussed in Part II.C of this manual, in field CHR.HMN.SUM. The date of the most recent revision to this summary is recorded in field CHR.HMN.DATE.

TOPIC AREA #9: CHRONIC TOXICITY-AQUATIC

Subtopics 1 and 2 contain information about chronic toxicity studies for freshwater aquatic species and record the Maximum Acceptable Toxicant Concentration (MATC), the Highest-No-Observed-Adverse-Effect Level (HNOAEL) and the Lowest Observed-Adverse-Effect Level (LOAEL) for fish and aquatic macroinvertebrates. The fields within these subtopics, as well as for subtopic 7, are given below:

Subtopic	Dictionary Name	Description
1.Chr.fish	CHR.FISH.SP CHR.FISH.TYPE CHR.FISH.HNOAEL CHR.FISH.LOAEL CHR.FISH.MATC CHR.FISH.REF CHR.FISH.TEXT	Chronic toxicity-freshwater fish Species tested Study type HNOAEL (mg/l) LOAEL (mg/l) MATC (mg/l) Reference Test conditions and results
2.Chr.inv	CHR.INV.SP CHR.INV.TYPE CHR.INV.HNOAEL CHR.INV.LOAEL CHR.INV.MATC CHR.INV.REF CHR.INV.TEXT	Chronic toxicity:freshwater macroinvertebrates Species tested Study type HNOAEL (mg/l) LOAEL (mg/l) MATC (mg/l) Reference Test conditions and results
7.Chr.aq.sum	CHR.AQ.SUM CHR.AQ.DATE	Topic area summary Summary date

Subtopics 1 and 2 contain both a tabular section and an associated textual section. The tabular sections list the species name (common and scientific), test type, HNOAEL (mg/l), LOAEL (mg/l), MATC (mg/l), and the reference number of the study denoted with an R-prefix in parentheses. The textual section for each subtopic contains pertinent information about the test conditions and results. The types of studies recorded generally fall into one of three categories: life cycle tests, partial life cycle tests, or embryo-larval tests. These study types are abbreviated as LC, PLC, and E-L respectively, in the field for study type. The test concentrations must be measured, rather than just estimated or nominal, if the studies are included in these subtopics.

Chronic aquatic toxicity studies included in Topic Area #9, as a general rule, meet the following criteria:

1. Chronic values are based on results of flow-through chronic tests (except renewal is acceptable for daphnids) in which the concentrations of test material in the test solutions were properly measured at appropriate times during the test.

2. Results of chronic tests in which survival, growth, or reproduction in the control treatment was unacceptably low are not recorded in these subtopics. The limits of acceptability will depend on the species.
3. Results of chronic tests conducted in unusual dilution water, e.g., dilution water containing high levels of organic carbon or particulate matter (e.g., higher than 20 mg/liter) are not included, unless a relationship is developed between toxicity and organic carbon or particulate matter or unless data show that organic carbon, particulate matter, etc., do not affect toxicity.
4. Chronic values are based on endpoints and lengths of exposure appropriate to the species. Therefore, only the results of the following kinds of chronic toxicity tests are used:
 - A. Life cycle toxicity tests consist of exposures of each of two or more groups of individuals of a species to a different concentration of the test material throughout a life cycle. To ensure that all life stages and life processes are exposed, tests with fish begin with embryos or newly hatched young less than 48 hours old, continue through maturation and reproduction, and end not less than 24 days (90 days for salmonids) after the hatching of the next generation. Tests with daphnids begin with young less than 24 hours old and last for not less than 21 days. For fish, data are obtained and analyzed on survival and growth of adults and young, maturation of males and females, eggs spawned per female, embryo viability (salmonids only) and hatchability. For daphnids, data are obtained and analyzed on survival and young per female.
 - B. Partial life cycle toxicity tests consist of exposures to each of two or more groups of individuals of a fish species to a different concentration of the test material through most portions of a life cycle. Partial life cycle tests are conducted with fish species that require more than a year to reach sexual maturity, so that all major life stages can be exposed to the test material in less than 15 months. Exposure to the test material begins with immature juveniles at least 2 months prior to active gonad development, continues through maturation and reproduction, and ends not less than 24 days (90 days for salmonids) after the hatching of the next generation.

Data are obtained and analyzed on survival and growth of adults and young, maturation of males and females, eggs spawned per female, embryo viability (salmonids only) and hatchability.
 - C. Early life stage toxicity tests consist of 28- to 32-day (60 days post hatch for salmonids) exposures of the early life stages of a species of fish from shortly after fertilization through embryonic, larval, and early juvenile development. Data are obtained and analyzed on survival and growth.
5. A chronic value (MATC) is obtained by calculating the geometric mean of the lower and upper chronic limits from a chronic test. A lower chronic limit is the

highest tested concentration in an acceptable chronic test, which does not cause the occurrence (statistically significantly different from the control at $P = 0.05$) of a specified adverse effect, and below which no tested concentration caused such an occurrence. An upper chronic limit is the lowest tested concentration in an acceptable chronic test, which did cause the occurrence (statistically significantly different from the control at $P = 0.05$) of a specified adverse effect and above which all tested concentrations caused such an occurrence.

6. Because various authors use a variety of terms and definitions to report the results of chronic tests, reported results should be reviewed carefully.

The data entered in the tabular sections in subtopics 1 and 2, including the fields for species tested, study type, HNOAEL, LOAEL, and MATC, are intended to be searchable by computer. Therefore, only one value may be entered per field, per line. For studies reporting multiple such parameters or endpoints, more than one line of tabular data will be necessary. All tabular lines should have data appearing in each of the searchable fields. A single textual section (test conditions and results) may then comprehensively address all the tabular data entered for the study.

Subtopic 7 contains a summarization of this topic area, as discussed in Part II.C of this manual, in field CHR.AQ.SUM. The date of the most recent revision to this summary is recorded in field CHR.AQ.DATE.

TOPIC AREA #10: PHYTOTOXICITY

Subtopic 1 contains fields for the collection of terrestrial and aquatic phytotoxicity data. Fields within this subtopic include:

Dictionary Name	Definition
PHYTO.TER	Phytotoxicity: Terrestrial Plants
PHYTO.TER.REF	Reference
PHYTO.AQ	Phytotoxicity: Aquatic Plants
PHYTO.AQ.REF	Reference
PHYTO.SUM	Topic area summary
PHYTO.DATE	Summary date

PHYTO.TER is the field containing information on terrestrial phytotoxicity, in textual format. The reference number, denoted with an R-prefix in parentheses, is recorded in field PHYTO.TER.REF. The textual field contains studies focusing on the phytotoxic effects of chemicals on terrestrial plants. Studies of acute or chronic duration are reported in this field. A wide range of studies involving any or all crucial stages of terrestrial plant life cycles (including seed, seedling, mature plant and reproductive structures) are included.

Conditions crucial to the responses of plants to chemicals are described in this field (e.g., temperature, humidity, water, light, growth medium and mineral nutrition). Plant genus and species, stage of development, duration of exposure to toxicant and dosage range, state of exposure (pre-plant, pre-emergence, or post-emergence), chemical formulation, type of application (foliar spray, soil incorporation or seed treatment) and exposure site (laboratory, greenhouse or field) used in the study are also important. Types of studies reported include seed germination, seedling evaluation, growth effects, and species or population shifts. Soil micro-organism studies with results important to plant growth and yield are also included. Ideal studies include all crucial stages of the plant life cycle and are performed in field studies using an appropriate vehicle.

Effects reported include changes in growth such as production of protoplasm and cellular development, yield, plant quality, seed quality, reproduction, degree of foliar or root injury or gas-exchange factors. Injury may be measured by alterations in metabolism, reductions in photosynthesis, foliar necrosis or chlorosis, leaf fall or growth reduction.

Although tests conducted in field plots with chemicals applied via water vehicle are most ideal, greenhouse studies and laboratory studies should also be collected. In vitro biochemical tests are not collected, as correlations to in vivo results are reportedly poor. Studies assessing the effects of toxic chemicals on plants are included. Studies on mechanisms of toxicant action are not collected at the present time, however, plant uptake and translocation studies should be collected. Plant cytogenetic assays for mutagenicity are reported in Topic Area #12: Mutagenicity, subtopic 2. Due to the large number of studies that may be available on the efficacy of herbicides, a few high quality studies are selected and reported in this field.

PHYTO.AQ is the field containing information on aquatic phytotoxicity, in textual format. This field contains information dealing with the effects of chemical exposure on aquatic plants, including both macrophytes and algae. Studies of acute or chronic duration are reported in this field. A wide range of studies involving any or all stages of aquatic plant life cycles are included. PHYTO.AQ.REF contains the reference number denoted with an R-prefix in parentheses.

PHYTO.AQ is a narrative field containing species name (common and scientific) and pertinent information about test conditions and test results. Duration of exposure to toxicant, toxicant concentration, chemical formulation (pesticides), and exposure site (laboratory or field study) are important test conditions to be included.

The toxicity endpoints reported vary and may include such endpoints as chlorophyll a production, reduced cell count, and lethality. Test duration may range from minutes to weeks.

With the exception of the two references noted below, procedures for conducting and interpreting the results of toxicity tests with aquatic plants are not well developed or standardized.

1. U.S. Environmental Protection Agency. 1978. The *Selenastrum capricornutum* Printz Algal Assay Bottle Test. EPA-600/9-78-018.
2. American Society for Testing and Materials. Draft. Proposed New Standard Guide for Conducting Static Toxicity Tests With Duckweed. American Society for Testing and Materials Committee E-47.

Due to the large number of studies that may be available on the efficacy of aquatic herbicides, a few high quality studies are selected and reported for aquatic herbicides.

The information in this topic area is collectively summarized, as discussed in Part II.C of this manual, and recorded in field PHYTO.SUM. The date of the most recent revision to this summary is recorded in field PHYTO.DATE.

TOPIC AREA #11: CARCINOGENICITY

Subtopic 1 contains a single field, CARC.NCI, for the carcinogenicity determination made by NCI/NTP. Text in this field includes a brief summary of any conclusions made by the National Cancer Institute/National Toxicology Program as a result of chronic studies to assess the potential carcinogenicity of selected chemicals. Generally, summarizing the final paragraph of the report's abstract provides an adequate amount of information for this field. This summary includes any conclusions and, when appropriate, the tissues types with tumors for each sex and species. The reference number (R-#) for the determination is included at the end of this textual field.

Subtopic 2 contains a single field, CARC.IARC. The text in this field consists of a summary of the evaluation by the International Agency for Research on Cancer's (IARC) Working Group. This information is available from the IARC Monographs and is summarized from the Comments or Summary section (generally, section 4) of the monograph for a particular chemical. This section of the monograph contains the Working Group's critical review of the data reported, including the degree of evidence for carcinogenicity to experimental animals and humans. The reference number (R-#) is cited at the end of this textual field.

Subtopic 3 contains two textual fields: CARC.NIOSH and CARC.AGENCY. CARC.NIOSH is a textual field containing a brief description of the National Institute of Occupational Safety and Health (NIOSH) determination on the carcinogenicity of the chemical. This field cites the conclusions identified in NIOSH Current Intelligence Bulletin publications or from other appropriate NIOSH documents when available. Summaries in this field briefly cite any chronic toxicity or carcinogenicity studies as reported in the conclusions and recommendations section of the publications. CARC.AGENCY contains any determinations made by respected agencies other than NCI/NTP, IARC, or NIOSH. For each of these fields, each textual data entry ends with the reference number (R-#).

Subtopic 4 contains the field CARC.POS, which is a listing of positive carcinogenicity references. Subtopic 5 contains the field CARC.NEG, which is a listing of negative carcinogenicity references. Data in these fields consist only of the numerical reference number denoted with an R-prefix, from studies providing positive or negative evidence of carcinogenic effects. These studies are described in greater detail under subtopics 6, 7, and 8. Inclusion on either of these lists should be based on the determinations made by the authors of the studies. Alternatively, studies may be listed here if the authors did not make a determination, but staff were able to deduce a conclusion based on the information provided. A study reporting positive findings in a species/strain should be recorded as a

positive reference. A study reporting negative findings under all protocols with a given species/strain should be recorded as a negative reference.

Subtopic 6 contains the following fields for information from animal studies which have been done to investigate the carcinogenic potential of a chemical:

DICTIONARY NAME	DESCRIPTION
CARC.AN.SP	Species tested
CARC.AN.ROUTE	Exposure route
CARC.AN.DOSE	Dose (mg/kg/d, or, mg/m (ihl))
CARC.AN.SCH	Dosing schedule
CARC.AN.REF	Reference
CARC.AN.TEXT	Test conditions and results

These associated fields are organized in a tabular format in CESARS, with columns for species, route, dose, dosing schedule, and corresponding reference number denoted with an R-prefix in parentheses. The species, route, and dose fields are designed to be searchable. Abbreviations used in the species and route fields are identified in Appendix D1 and Appendix D2, respectively, and must be strictly adhered to. The administered dose should be in standard units of mg/m if the route is inhalation; for all other routes, dose should be in standard units of mg/kg/d. In this situation mg/kg/d is the actual administered daily dose. It is not a time-weighted-average or a study-average dose, unless the author has reported it that way. If the reported dose was converted to standard units by the reviewer, the dose as reported by the author is included in the Dosing Schedule field. Following this tabular section is an associated text field, CARC.AN.TEXT, which consists of test conditions and results. The text field may address one, or several, lines of tabular data. Since the dose field is numeric and searchable, and therefore can have only one value per line, several lines of tabular information are often necessary. If multiple lines of tabular information are used for a single data entry, the species, route, and dose fields must be filled in for each line. However, complex studies, utilizing multiple species, routes, doses, or schedules, may be summarized with better clarity by dividing them into separate data entries with distinct textual fields.

Field CARC.AN.TEXT is a textual field with test conditions and results sections. The details listed in the test conditions include, when available, the strain and sex of animals used, the number of animals per treatment group, the age of animals at the onset of the study, the information on any vehicle used, details of the negative and positive controls used, details on planned interim sacrifices, and which organs and tissues were examined histologically. If the reported dose was converted to standard units by the reviewer, method used and assumptions made for the conversion should be described in this section. The results section reports details concerning the major health effects such as early mortality due to toxicity; however, the major emphasis for this summary is on tumor-related pathology. The narrative includes details on statistically significant tumor incidences; these are generally reported as organ-specific tumors or those from common

morphological tissues. The author's conclusions for the study, as well as any additional factors which could complicate the conclusions or compromise a determination of the study's adequacy (e.g., peculiarities or blatant deficiencies in the statistical analyses) are included in the summary.

There is the potential for toxicity information in this subtopic to overlap with that in Topic Area #7: Chronic Toxicity-Terrestrial Life. Generally, non-tumor related pathology and the information concerning clinical toxicological observations are reported in detail in Topic Area #7 and are only briefly cited in this subtopic.

Subtopic 7 contains several associated fields for the summarization of studies which investigate the ability of a chemical to cause cancer in humans. Those fields are:

DICTIONARY NAME	DESCRIPTION
CARC.HMN.ROUTE	Exposure route
CARC.HMN.DOSE	Dose (units may vary)
CARC.HMN.SCH	Dosing schedule
CARC.HMN.REF	Reference
CARC.HMN.TEXT	Test conditions and results

These associated fields are organized in a tabular format in CESARS, with columns for route, dose, schedule, and reference number denoted with an R-prefix in parentheses. The route field is designed to be searchable, using the abbreviations identified in Appendix D2. The tabular information is followed by the CARC.HMN.TEXT field, a text field divided into test conditions and results sections. The test conditions section provides details on the types of exposures, a discussion of the estimated doses, number of persons exposed, type of epidemiology study (e.g., cross-section, cohort, case-control) and details on control populations. The results section provides details on the presence or absence of potential tumorigenic effects. Factors which could complicate a study's interpretation are included, as are details on uncontrolled variables, discussions of any difficulties encountered in doing the statistical comparisons, or problems in isolating exposure details.

Subtopic 8 contains CARC.OTHER, a textual field, and CARC.OTH.REF, a field for the reference number denoted with an R-prefix in parentheses. The narrative in CARC.OTHER summarizes studies which investigate the carcinogenic potential of a chemical by evaluating endpoints other than tumorigenicity in whole animals or humans and also includes initiation/promotion studies. Other types of studies included in this field are in vitro cell transformation assays or in vivo enzyme altered foci assays. Since this field may have a wide disparity in the types of studies reported, general guidelines for summarized details are necessarily broad. The narrative begins with a statement of purpose for the study; this introduces the data and identifies the types of information found therein.

The in vitro mammalian cell culture transformation systems have generally been shown to have good correlation with known tumorigenicity in vivo. There are a variety of cultured embryo, fibroblast, and epithelial cell lines which might be used in these assays. General parameters briefly detailed in summaries for the in vitro assays include the identity of the cultured cells, pertinent test protocols, a description of the dosing regime, information concerning positive and negative controls, details on endpoints, the evaluation criteria used, and the author's conclusion from the study. For summaries of initiation/promotion studies, additional details such as information on the procedures followed, chemical treatment for initiation or promotion, doses, dosing schedule, observation period, and endpoints evaluated are reported.

Subtopic 9 contains a summarization of this topic area, as discussed in Part II.C of this manual, in field CARC.SUM. The date of the most recent revision to this summary is recorded in field CARC.DATE.

TOPIC AREA #12: MUTAGENICITY

This topic area contains information on various types of mutagenicity studies which utilize in vivo and in vitro techniques for evaluating the mutagenic potential of a chemical. The mutagenicity tests, test results, and other information relevant to the topic area are grouped into basic categories, which in turn, are placed in subtopics. Subtopics 1, 2, and 3 contain the basic categories: Gene Mutations, Chromosomal Aberrations, and DNA Damage, respectively. Subtopic 4 contains Other Mutagenicity Studies, and subtopic 5 contains the topic area summary. The following is a listing of the fields of this topic area.

SUBTOPIC	DICTIONARY NAME	DESCRIPTION
1. Mut.gene	MUT.GENE.POS	Gene mutation, positive references
	MUT.GENE.NEG	Gene mutation, negative references
	MUT.GENE.STUDY	Gene mutation studies
	MUT.GENE.TYPE	Assay type
	MUT.GENE.SP.CELL	Species and cell type
	MUT.GENE.RTE	Exposure route
	MUT.GENE.DOSE	Dose
	MUT.GENE.REF	Reference
	MUT.GENE.TEXT	Test conditions and results
	MUT.CHM.POS	Chromosomal effects, positive references
2. Mut.chm	MUT.CHM.NEG	Chromosomal effects, negative references
	MUT.CHM.STUDY	Chromosomal effect studies
	MUT.CHM.TYPE	Assay type
	MUT.CHM.SP.CELL	Species and cell type
SUBTOPIC	DICTIONARY NAME	DESCRIPTION
3. Mut.DNA	MUT.CHM.RTE	Exposure route
	MUT.CHM.DOSE	Dose
	MUT.CHM.REF	Reference
	MUT.CHM.TEXT	Test conditions and results
	MUT.DNA.POS	DNA damage/repair, positive references
	MUT.DNA.NEG	DNA damage/repair, negative references
	MUT.DNA.STUDY	DNA damage/repair studies
	MUT.DNA.TYPE	Assay type
	MUT.DNA.SP.CELL	Species and cell type
	MUT.DNA.RTE	Exposure route
4. Mut.other	MUT.DNA.DOSE	Dose
	MUT.DNA.REF	Reference
	MUT.DNA.TEXT	Test conditions and results
5. Mut.sum	MUT.OTHER	Other mutagenicity studies
	MUT.OTH.REF	Reference
5. Mut.sum	MUT.SUM	Topic area summary
	MUT.DATE	Summary date

Subtopic 1 contains summaries of mutagenicity studies which attempt to detect gene damage. Gene mutations have been referred to as microlesions or alterations of the gene

sequence at the nucleotide level. These alterations may be base-pair substitutions (a qualitative change in one or a few nucleotide pairs) or frameshifts (base-pair additions/deletions, which are quantitative changes in one or a few nucleotide pairs).

Subtopic 2 contains summaries of mutagenicity studies designed to identify deleterious effects on chromosomes. Chromosomal mutations could be numerical (ploidy changes), involving complete loss or gain in chromosomes, or structural (clastogenic). Structural chromosomal aberrations include chromosome or chromatid breaks, deletions, or rearrangements such as translocations or nondisjunctions.

Subtopic 3 contains summaries of studies investigating direct DNA damage or abnormal DNA repair mechanisms in various prokaryotic or eukaryotic cells, or organisms. Stimulation of the DNA repair activity level following chemical treatment at sublethal concentrations has been shown to be a good general indicator of DNA-directed toxicity and damage. Mutagenicity studies which give evidence of damage to DNA may be valuable predictors of carcinogenic activity since there is increasing correlative evidence that chemicals which induce DNA damage are carcinogenic. Examples of detectable DNA damage are missing, incorrect, or altered purine or pyrimidine bases; interstrand cross-links; and strand breaks.

Subtopic 4 contains summaries of mutagenicity studies which cannot be readily classified under any of the previous three subtopics. Some assay systems may have predictive value as screening tests for genotoxic effects, yet the measured end point may not result from a classifiable mutational event, and the mechanism for a measured end point cannot be clearly established. Examples are tests for sperm head abnormalities, DNA binding, cataract-mutation, dominant skeletal mutation and sister chromatid exchange (SCE). While it is unknown whether the variants in sperm result from mutations, there appears to be good correlation with this end point and potential carcinogenic effects. It is thought to be unlikely that fertilization by a malformed sperm constitutes an increased genetic hazard to the fertilized egg. The cataract-mutation and dominant skeletal mutation assays may represent a spectrum of events, including gene mutations, small deficiencies, heritable translocations, and various chromosomal syndromes. Another mutagenicity assay that has recently been the source of some controversy as to the exact genetic end-point purported to be detected is the sister chromatid exchange (SCE) assay. Because the molecular mechanism of SCE formation has not been fully elucidated, a classification of this test system under one of the basic categories of genetic assays has not been possible. Results from this assay would be considered within the context of other test results in the overall evaluation of the mutagenic potential of a chemical.

Subtopics 1, 2, and 3 are each divided into a searchable tabular format and a textual section for each summarized study. Each subtopic also contains fields for the collection of positive and negative references. The nature of these fields will be discussed later in this topic area description. For subtopics 1, 2, and 3, the tabular fields contain the following information from each study: assay type, species-cell type, route of exposure, doses used, and a reference number denoted with an R-prefix. The first three columns are designed to be text-word searchable as fields using standard terminology as shown in Tables 1-3 below and abbreviations in Appendix D5. The textual portion consists of the test conditions and results in narrative format.

The information listed in the test conditions describes the experimental methods of the study. Necessary details generally include a brief statement of the assay protocol. If a particular assay is considered well-standardized, e.g. the Ames assay, this discussion may be omitted. If a given assay utilizes some modifications of a standard protocol, these differences are noted. Information concerning any metabolic activation system includes details on the microsomal enzyme system inducer used to pretreat the rodents prior to isolation of the liver microsomal fractions, or details on the nicotinamide adenine dinucleotide phosphate (NADPH) generating system. The test conditions should also include a description of the test organisms/cell line (e.g., species/strain); details of treatment and dosing protocol; and whether assays were *in vivo* tests with animals or *in vitro* tests with bacterial, fungal, plant, or mammalian cell systems. For cell-mediated or host-mediated assays, treatment techniques and test organism recovery operations are summarized briefly. The evaluation criteria used for a given assay are cited.

The results section includes details of the test chemical's effects or absence of effects in the assay. The author's final evaluation of the assay results and the significance is also included, when available. Important details concerning any toxic effects to the test organisms/ cells are reported.

Subtopic 4, Other mutagenicity studies, does not contain a tabular section. Appropriate information for the textual field MUT.OTHER includes those parameters discussed above for the other subtopics (i.e., assay type, species and cell type, route and dose). Separate headings for test conditions and results are not generally included. Each study reported in this field begins with a brief description and statement of purpose for the assay. This is followed by the narrative text, and is followed by the assigned reference number denoted with an R-prefix in parentheses in field MUT.OTH.REF.

As previously mentioned, the first three columns of subtopics 1, 2 and 3 (assay type, species-cell type, and route) are text-word searchable. To facilitate searching, uniformity in terminology is maintained by use of certain key words and abbreviations in these columns. Tables 1, 2, and 3 below enumerate the standardized terminology which is subdivided by general categories when possible. For each example the assay types are listed with the corresponding species-cell type and route of exposure. These are entered into the first three columns (fields) of the appropriate subtopic. In many cases, there is only the assay type and corresponding species-cell type listed when the summarized assay is clearly an *in vitro* assay. For these cases, the route column is left blank. In order to be technically correct, the species and genus names used in the subsequent descriptions for species-cell type are underlined. However, limitations of the computer hardware have prevented this format in the CESARS database.

The fields of positive and negative references found in subtopics 1, 2 and 3 are designed to contain only the appropriate reference numbers denoted with an R-prefix. The study determinations are those made by the respective authors, or when no author determination is made, the studies are evaluated and determinations may be made by the reviewer, utilizing all available data emerging from the study. The positive and negative findings to be cited in these fields include specific assay types, on specific species/strains, with specific test protocols (e.g., with or without a metabolic activation system). For example, an Ames assay with positive results in strain TA98 and negative results in strain TA100

would be cited in both fields. An Ames assay with positive findings in the presence of an S9 fraction and negative findings in the absence of S9 would also be cited in both fields.

Subtopic 5 contains a summarization of this topic area, as discussed in Part II.C of this manual, in field MUT.SUM. The date of the most recent revision to this summary is recorded in field MUT.DATE.

TABLE 1

Controlled Vocabulary for Subtopic 1 (gene mutation studies):

Bacterial genotoxicity assays:

Assay Type	Species - Cell Type	Route
Ames assay (with the specific strains used)	Salmonella typhimurium	
WP2 assay (with the specific strains used)	Escherichia coli	
bacterial mutation assay species and strain used		
host-mediated	mus	
- Salmonella typhimurium;		orl (in this example
microbial mutation test	dosing of the compound to the host species was by gavage)	

Fungal genotoxicity assays:

Assay Type	Species-Cell Type	Route
yeast mutation assay	Neurospora crassa or Saccharomyces cerevisiae	
fungal mutation assay	Aspergillus nidulans	

Assays in cultured mammalian cells:

Assay Type	Species-Cell Type	Route
mammalian cell forward mutation (used as general classification when assay has no specific common name)		
HGPRT assay	Chinese ham - V79 cells, human fibroblasts	
ouabain resistance	rat-embryo cells	
microsome-mediated assay		
TK assay	L5178Y mus-lymphoma cells	

Tests in *Drosophila*:

Assay Type	Species-Cell Type	Route
sex-linked recessive lethal	<i>Drosophila melanogaster</i> or l	
somatic mutation assay	<i>Drosophila melanogaster</i> or l	
attached-X test	<i>Drosophila melanogaster</i> or l	

Tests in mammals:

Assay Type	Species-Cell Type	Route
spot test	mus	or l
specific-locus test	mus	or l

Tests in vascular plants:

Assay Type	Species-Cell Type	Route
plant mutation assay		
stamen-hair test	<i>Tradescantia</i>	vapors

TABLE 2
Controlled Vocabulary for Subtopic 2 (chromosomal effects studies):

Assay Type	Species-Cell Type	Route
in vitro cytogenetics	Chinese ham - fibroblasts	
in vivo cytogenetics	hmn - peripheral blood lymphocytesihl	
plant cytogenetics	Vicia faba - bud or root cellsspray	
dominant lethal	mus or Drosophila melanogasterorl	
heritable	mus or Drosophila melanogasterorl	
translocation assay		
nondisjunction test	Drosophila melanogasterorl	
micronucleus test	mus-erythrocyteipr	
X and Y loss	Drosophila melanogasterorl	
chromosomal aberrations (used when a more specific name cannot be identified)		

TABLE 3

Controlled Vocabulary for Subtopic 3 (DNA damage/repair studies):

Assay Type	Species-Cell Type	Route
unscheduled DNA synthesis	hmn - HeLa S3 cells	
hmn - skin epithelial cells		
hmn - transformed SV-40 cells (VA-4)		
hmn - transformed SV-40 fibroblast cells		
DNA damage/repair	Bacillus subtilis	
<i>Proteus mirabilis</i>		
rat hepatocyte		
DNA repair		
inhibition	hmn - lymphocytes	
HPC/DNA repair test	rat, mus, or ham - hepatocyte	
inhibited DNA synthesis	Chinese ham - ovary cells	
Chinese ham - lung fibroblast		
Chinese ham - V79		
rat - lung cell line ARC-12		
rec test	Escherichia coli AB 1157, JC5519	
Bacillus subtilis		
host mediated mitotic recombination fidelity of DNA synthesis	mus - <i>Saccharomyces cerevisiae</i>	
DNA fragmentation	avian myeloblastosis virus	
hmn - skin fibroblast cells	Syrian golden ham - embryo cells	
Pol A test	Escherichia coli	
mitotic recombination D3, D4, D5, or D7	<i>Saccharomyces cerevisiae</i>	
mitotic gene conversion	<i>Saccharomyces cerevisiae</i> MP-1	
mitotic crossing-over		

TOPIC AREA #13: REPRODUCTIVE AND DEVELOPMENTAL EFFECTS

The studies appropriate for inclusion into these fields examine the effects of a test compound on reproductive parameters such as parental reproductive function and activity, fertility, conception, pregnancy, parturition and the growth and development of offspring from conception through maturity. These parameters can be examined via single or multigeneration studies. The following subtopics are those for which we will routinely be collecting information.

Subtopic 1 contains information from mammalian reproductive and developmental studies. Eight fields are included in this subtopic and they include the following:

Dictionary Name	Description
REP.MAM.POS	Repro./Devel. effects, positive references
REP.MAM.NEG	Repro./Devel. effects, negative references
REP.MAM.SP	Species tested
REP.MAM.RTE	Exposure route
REP.MAM.DOSE	Dose (mg/kg/d)
REP.MAM.SCH	Dosing schedule
REP.MAM.REF	Reference
REP.MAM.TEXT	Test conditions and results

REP.MAM.POS and REP.MAM.NEG are listings of those studies which report positive or negative results on the reproductive and developmental effects of a chemical in mammals. The studies are listed in the appropriate field by reference number only which is prefaced with R-. A study reporting positive findings in a species/strain should be recorded as a positive reference. A study reporting negative findings under all protocols with a given species/strain should be recorded as a negative reference.

The remaining six associated fields report information from mammalian reproductive and developmental studies. All are presented in a tabular format with the data entered in the appropriate fields. Species tested and the exposure route are entered using the appropriate abbreviations as presented in Appendix D2. The dose must be entered in units of mg/kg/d. In this situation mg/kg/d is the actual administered daily dose. It is not a time-weighted-average or study-average dose, unless the author has reported it that way. All three of these fields, species, route and dose, are maintained as searchable fields which means that only one entry can be made into the field per line. The dosing schedule should be summarized as concisely as possible and should include the dose as presented by the author if a conversion was made by staff. The reference is denoted with an R-prefix in parentheses. The test conditions and results contain the summarized, pertinent information and data from a particular study. The test conditions section describes the experimental methods of the study and should include the following when possible: the sex, strain and age of animals; number of subjects in control and dose groups; vehicle used for compound administration; further description of the dosing regime if the information in the tabular section is insufficient; any unusual events or shortcomings of the study; and parameters evaluated. If the reported dose was converted to standard units (mg/kg/day) by the reviewer, the method used and assumptions made for the conversion should be described in

this section. The results section includes information relating to the effects of the test compound on the various reproductive and developmental parameters examined. An important factor is the author's evaluation of the relationship, or lack thereof, between the exposure of the organism to a particular dose of the test substance and the incidence and severity of all abnormalities occurring at the specified dose levels. A No-Observed-Adverse-Effect Level (NOAEL), which is the highest dose level at which no observed adverse effect is seen, may be included in the author's evaluation. The NOAEL may be used to calculate levels of exposure to the test compound for humans and other species in various exposure situations. This piece of datum should be included in the results section. If an author's summary does not specifically identify a NOAEL and the results of the study clearly indicate a dose level at which no adverse effects are observed, it is important to report this value as a NOAEL.

The fields in subtopic two are similar to the mammalian animal fields, the only difference being that they deal specifically with human studies. A total of five associated fields are incorporated into this subtopic and they include exposure route (REP.HMN.ROUTE), dose (REP.HMN.DOSE), dosing schedule (REP.HMN.SCH), reference (REP.HMN.REF) and test conditions and results (REP.HMN.TEXT). The guidance provided above for the mammalian animal fields can be followed for the human fields. However, there is no standardized unit for dose; the dose should be recorded as it is reported by the author.

Other kinds of reproductive and developmental studies which do not fit into subtopics 1 or 2 should be entered into subtopic 3, Other Animal Studies. "Other animal studies" includes in vitro studies which are designed to examine the effects of a test compound on developing cells, tissues, organs, or organisms. They may also study the developmental processes of an embryo or fetus by transplanting or explanting it from its normal environment. Only those in vivo studies examining effects to terrestrial nonmammalian species (e.g., avian) nonaquatic animals should be included here. The data should be reported and summarized into the five fields in the same manner as discussed in the mammalian animal and human reproductive subtopic areas. The associated fields included in this subtopic are the species tested (REP.OTH.SP), exposure route (REP.OTH.ROUTE), dose (REP.OTH.DOSE), dosing schedule (REP.OTH.SCH), reference # (REP.OTH.REF) and text (REP.OTH.TEXT). As with human studies, the dose should be recorded as reported by the author.

Subtopic 4 contains two fields, REP.PL.TRANS.POS and REP.PL.TRANS.NEG, for the citing of studies reporting the occurrence or lack of placental transfer of the test compound. These fields should contain only the reference number with an R- prefix from appropriate studies.

The NOAEL, which was also reported in the text of the previous subtopic areas, is reported in subtopic 5 in tabular, searchable format. The three fields include the species tested (REP.NOAEL.SP), the NOAEL in (REP.NOAEL) and the reference (REP.NOAEL.REF). No other details are to be reported here. If the NOAEL is from a mammalian animal study, it should be recorded in mg/kg/d.

Subtopic 6 contains a summarization of this topic area, as discussed in Part II.C of this manual, recorded in field REP.TER.SUM. The date of the most recent revision to this summary is recorded in field REP.TER.DATE.

TOPIC AREA #14: OTHER ADVERSE EFFECTS

This topic area was created for those studies which do not seem to fit into the other specific topic areas. Subtopic 1 contains the fields OTH.ADV.TEXT and OTH.ADV.REF for recording "other adverse effects" data and the reference number, respectively. Types of studies summarized in OTH.ADV.TEXT include those that investigate a compound's ability to affect aesthetic properties by imparting undesirable taste, odor, or color to water or fish. (The final odor and/or taste threshold values are also reported in the Topic Area #1 fields ODOR.WATER and TASTE.THR). Studies investigating foaming properties are also included here. In vitro cytotoxicity studies which utilize cultures of liver cells, brain cells, or standard cell line cultures such as HeLa cells and bacterial toxicity studies, would be reported in this field, but are not routinely collected.

This field is in a narrative format, and the data recorded do not require a separate test conditions and results section. The data entered should include a brief description of the methodology, dose levels, and the resulting effects. Extensive detail is not included.

The information in this topic area is summarized, as discussed in Part II.C of this manual, and recorded in field OTH.ADV.SUM. The date of the most recent revision to this summary is recorded in field OTH.ADV.DATE.

TOPIC AREA #15: PHARMACOKINETICS

Topic Area #15, Pharmacokinetics, contains information on the uptake, distribution, biotransformation, and elimination of a compound by terrestrial organisms. Studies containing this type of information are generally, but not exclusively, in vivo studies. Following are the fields in this Topic Area:

Subtopic	Dictionary Name	Description
1.Pharmacokinetics	PHARM.TEXT	Pharmacokinetics/Metabolism studies
	PHARM.REF	Reference
	PHARM.SUM	Topic area summary
	PHARM.DATE	Summary date

As a general guideline, information pertaining to actions performed by an organism or system upon a chemical should be included in the PHARM.TEXT textual field; while information related to the effects of a chemical upon a biological system is included in the specific pertinent fields in other topic areas. A study describing the ability of liver microsomes to biotransform a chemical *in vitro* would be appropriate in this field, but information involving alterations in metabolism produced by exposure to a chemical *in vitro* (or *in vivo*) would not be appropriate.

Many reports include information about the production of toxic metabolites via biotransformation of the original compound. This information belongs in PHARM.TEXT but if additional toxicity data on the metabolites are available, they should be placed in the appropriate toxicity fields.

Prior experience with the collection of this type of data has demonstrated that it is a very difficult and time-consuming endeavor. For many studies, evaluation and summarization of the data require specific training or experience in the field of pharmacokinetics. In the recent past, these factors necessitated that pharmacokinetics data not be routinely collected. However, it is recognized that this information can be very relevant in the subsequent assessments for the chemical. It is currently felt that a compromise is necessary.

Therefore, when a chemical evaluation is being done and pharmacokinetics studies are found, their availability will be recorded in CESARS if those data appear to be significant. Without fully reviewing, evaluating, or summarizing the data, a very brief (one or two sentences) entry should be recorded in the textual field PHARM.TEXT, with the reference number recorded in the reference field PHARM.REF. The brief narrative statement can generally be derived from the study title or abstract. The result of this routine will be a topic area containing a list of studies on the pharmacokinetics of the chemical, with a brief description of each. Secondary as well as primary references should be collected.

Examples are:

Absorption of Chemical-X from the gut of orally-dosed rats was studied. Absorption was rapid and complete. (R-125)

This review contains a discussion of the *in vivo* metabolism of Chemical-X to reactive metabolites. Major metabolites are Y and Z with Y predominant at low doses. (R-126)

For this topic area, this is the data collection routine that normally will be followed. The topic area summary fields should be left blank in this situation.

After completion of the chemical evaluation, the need may arise for detailed data on pharmacokinetics. The citations in this topic area will then serve as a useful list of available studies. If those studies are then reviewed, they should be summarized by the reviewer and entered in field PHARM.TEXT as replacements for the initial brief descriptions. These entries should contain information such as uptake and clearance rate, experimental conditions, biotransformation location, tissue half-life, major metabolites and route of excretion, when available. The information found in a paper's summary or abstract may be sufficient for the purposes of this field.

If most of the brief entries in this topic area are subsequently reviewed more thoroughly, the topic area summary should then be performed. PHARM.SUM is the textual field for the topic area summary, as discussed in Part II.C of this manual. The date of the most recent revision to this summary is recorded in field PHARM.DATE.

TOPIC AREA #16: BIOACCUMULATION/BIOCONCENTRATION

Subtopic 1 contains information about the bio-uptake (concentration and accumulation) of chemicals by freshwater or marine organisms. Data on fish and bivalve molluscs may be considered the most relevant and significant. However, such data involving other aquatic organisms should also be collected here. This subtopic contains both a tabular section and a textual section. The tabular section contains 8 associated fields arranged as columns: species name (common and scientific), reported bioconcentration factor (BCF), type of test, duration of test (in days), tissue type, percent lipid content, exposure concentration (mg/l), and reference number of the study denoted with an R-prefix in parentheses. The textual section contains pertinent information about test conditions and test results. The dictionary names for these fields are presented below:

DICTIONARY NAME	DESCRIPTION
BCF.SP	Species tested
BCF.VALUE	BCF value reported
BCF.TEST	Test type
BCF.DUR	Test duration (days)
BCF.TIS	Tissue type examined
BCF.FAT	Percent lipid content of tissue examined
BCF.EXP	Exposure conc. (mg/l)
BCF.REF	Reference
BCF.TEXT	Test conditions and results
BCF.SUM	Topic area summary
BCF.DATE	Summary date

The textual section includes Test Conditions such as water chemistries (dissolved oxygen, temperature, pH, alkalinity, and hardness), life stage of the test organism, weight of the organism (fish), and the duration of the depuration and uptake phases of the study. The types of studies in this subtopic include both laboratory tests (flow-through and static) and environmental monitoring data when the concentrations in the water are measured. BCFs are reported on the basis of total body weight, organ weight, or percent lipid content of the organisms.

The standard format used in BCF.SP is to list the common species name followed by the scientific name in parentheses. The abbreviations listed in Appendix D4 are used to list the appropriate type of test (field BCF.TEST) and tissue type (field BCF.TIS). Some commonly used abbreviations which are used in the textual section are also found in Appendix D4.

The information in this topic area is collectively summarized, as discussed in Part II.C of this manual, and recorded in field BCF.SUM. The date of most recent revision to this summary is recorded in field BCF.DATE.

TOPIC AREA #17: Transport Processes

This topic area contains information from studies investigating chemical behavior in regards to transport among environmental media. Subtopic 1 contains text fields for the reporting of sorption studies and volatilization studies:

Dictionary Name	Description
TPORT.SORPTION.TEXT	Sorption studies, narrative
TPORT.SORPTION.REF	Reference
TPORT.VOL.TEXT	Volatilization studies, narrative
TPORT.VOL.REF	Reference
TPORT.SUM	Topic area summary
TPROT.DATE	Summary date

TPORT.SORPTION.TEXT is a text field for information pertaining to sorption (adsorption, absorption) of chemicals to particulate matter (suspended in water or air), soil, sediment or biota. Laboratory derived Langmuir and Freundlich isotherm data, equilibrium distribution/partition coefficients, and adsorption/sorption rates are examples of information found in this field. Some of the key elements of studies, which should be recorded when available, include the experimental conditions, medium, organic content, and rate constant. Following the narrative study description, the reference number is given with an R-prefix in parentheses in field TPORT.SORPTION.REF.

Also contained in subtopic 1 are volatilization studies. TPORT.VOL.TEXT is a text field for recording data on the physicochemical process of chemical transfer from water or soil solutions or from solid surfaces to the atmosphere. Experiments which refer to vaporization losses as "co-distillation with water" will also be recorded in this field. Volatilization rate constants, half-lives in water or soil, and effects of temperature, pH and wind velocities on volatilization rates are examples of information included in this field. Some of the key elements of studies, which should be recorded when available, include the experimental conditions, medium, rate constant, mass transfer coefficients (gas/liquid), Henry's Constant, and diffusion coefficient (water/air). Following the narrative study description, the reference number is given with an R-prefix in parentheses in field TPORT.VOL.REF.

The topic area summary, as discussed in Part II.C of this document, appears in field TPORT.SUM. The date of the most recent revision to this summary is recorded in field TPORT.DATE.

TOPIC AREA #18: ENVIRONMENTAL FATE PROCESSES; GENERAL

This Topic Area contains information on microcosm studies and field studies, and also any other environmental fate processes which do not have distinct CESARS fields for data collection. This Topic Area consists of a single subtopic, which is outlined below:

Subtopic	Dictionary Name	Description
1. General.fate. processes	FATE.MICROC.TEXT	Microcosm studies, narrative
	FATE.MICROC.REF	Reference
	FATE.FIELD.TEXT	Field studies, narrative
	FATE.FIELD.REF	Reference
	FATE.OTHER.TEXT	Other processes, narrative
	FATE.OTHER.REF	Reference
Subtopic	Dictionary Name	Description
	FATE.SUM	Topic area summary
	FATE.DATE	Summary date

FATE.MICROC.TEXT is a text field for the recording of data from microcosm studies. Microcosm studies include studies using microcosms or model ecosystems that are designed to predict the probable fate of the chemical in the natural environment. The distribution of the chemical and major metabolites in each compartment of the model system are reported. Some key elements to be included, when available, are the experimental conditions, system description, and the transport and transformation processes studied. Following the narrative discussion, the reference number is given with an R-prefix in parentheses in field FATE.MICROC.REF.

FATE.FIELD.TEXT is a text field for data on studies where a test compound is intentionally released into the environment and the concentration of the chemical is measured for a period of time to determine the environmental behavior of the chemical. Distribution patterns, routes and rates of loss from the study area, and major degradation products are examples of information reported in this field. Some key elements to be included, when available, are the experimental conditions, system description, and the transport and transformation processes studied. Following the narrative discussion, the reference number is given with an R-prefix in parentheses in field FATE.FIELD.REF.

FATE.OTHER.TEXT is a text field for studies on environmental fate processes which do not have distinct CESARS fields for data collection, yet could be of significant environmental consequence to the fate of the compound.

For any environmental fate data which appears significant yet does not seem to belong in the fields described in this document, Appendix C2 should be examined. Appendix C2, the complete CESARS database directory, includes several environmental fate fields not included in Appendix C1 (which includes only those data fields described in this document and routinely collected for a Chemical Evaluation). For example, photolysis data is not routinely collected, yet it may be significant for some chemicals. A review of Appendix

C2 shows that fields for the collection of photolysis data do exist in CESARS under Topic Area #19. Therefore, those photolysis-specific fields should be used for the recording of such data. On the other hand, hydration is a process for which studies would be recorded in FATE.OTHER.TEXT, since there are no specific CESARS fields for the collection of hydration data. Following the narrative discussion in this textual field, the reference number, denoted with an R-prefix in parentheses, is entered in field FATE.OTHER.REF.

The last two fields in subtopic 1 are for the topic area summary. FATE.SUM is a textual field for the summarization of data in this topic area, as discussed in Part II.C of this manual. The most recent revision to this summary is recorded in field FATE.DATE.

TOPIC AREA #19: TRANSFORMATION PROCESSES

This topic area contains information on transformation processes. Specific transformation processes include biodegradation, hydrolysis, reduction/oxidation, photolysis, and photooxidation. However, only data for the first two of these processes are currently routinely collected for CESARS when encountered in the literature. Therefore, this topic area consists of the following routinely-collected fields:

Subtopic	Dictionary Name	Description
1.Transformation.	TFORM.BIODEG.TEXT	Biodegradation studies; narrative processes
	TFORM.BIODEG.REF	Reference
	TFORM.HYDROL.TEXT	Hydrolysis studies; narrative
	TFORM.HYDROL.REF	Reference
	TFORM.SUM	Topic area summary
	TFORM.DATE	Summary date

TFORM.BIODEG.TEXT is a text field for studies on the degradation of chemicals by microorganisms. Both qualitative and quantitative data from studies such as river die-away, shake culture, activated sludge, trickling filter, anaerobic tests, etc., are included in this field. Experimental conditions are reported when available, including medium composition, oxygen requirements, temperature, pH, light, etc. Rate constants, half-lives, initial and final concentrations, and degradation products are reported when available. Following the narrative discussion in this textual field, the reference number, denoted with an R-prefix in parentheses, is placed in field TFORM.BIODEG.REF.

TFORM.HYDROL.TEXT is a text field for studies on the hydrolysis of compounds, as conducted in the environment and the laboratory. Hydrolysis is a chemical transformation process in which water reacts with another substance by cleaving chemical bond(s) to form two or more substances. This process does not include other possible reactions between chemicals and water such as acid/base reactions. Experimental conditions, hydrolysis rates, half-lives and hydrolysis products are examples of information included in this field. Also included in this field are pH dependent elimination reactions resulting in the formation of unsaturated chemical bonds. Excluded from this field are biologically mediated hydrolysis (biodegradation) and photochemically-induced hydrolysis (photolysis). Following the narrative discussion in this textual field the reference number, denoted with an R-prefix in parentheses, is given in field TFORM.HYDROL.REF.

The information in this topic area is summarized, as discussed in Part II.C of this manual, in field TFORM.SUM. The date of the most recent revision to this summary is recorded in field TFORM.DATE.

TOPIC AREA #21: REFERENCES AND CAS VOLUMES SEARCHED

This topic area contains the following subtopics and fields, for the recording of the references cited and the Chemical Abstracts volumes searched for the chemical evaluation:

Subtopic	Dictionary Name	Description
1. References	REF.TEXT	References cited in the C.E.
2. Lit.search	REF.CAS-BEGIN	Chemical Abstracts volumes searched; beginning
	REF.CAS-END	Chemical Abstracts volumes searched; ending

REF.TEXT is a text field containing all the references cited in the chemical evaluation. The reference citation is preceded by an R- prefix and the assigned reference number (e.g., R-17). The reference list should be in sequential numerical order according to the reference numbers. The references follow a standard format according to the type of publication:

- 1) For books with one author:

Sax, N.I. 1984. Dangerous Properties of Industrial Materials. 6th Edition. Van Nostrand Reinhold Co., N.Y., NY.

- 2) For books with two or three authors or editors:

McEwen, F.L. and F. R. Stephenson. 1979. The Use and Significance of Pesticides in the Environment. John Wiley and Sons, N.Y., NY.

Lewis, R. J., D. V. Sweet and A. M. Harding. 1984. Registry of Toxic Effects of Chemical Substances. Dept. of Health and Human Serv., National Inst. for Occupational Safety and Health. PB83-107-4.

- 3) For books with more than 3 authors or editors:

Windholz, M., et al., (Ed). 1976. The Merck Index. 9th Edition. Merck and Co., Inc., Rahway, NJ.

- 4) For journal articles:

(Abbreviations of journal titles as cited in Chemical Abstracts may be used).

Gage, J.C. 1970. The subacute inhalation toxicity of 109 chemicals. British J. Industrial Med. 27:1-18.

Liu, D. and K. Thomson. 1983. Toxicity assessment of chlorobenzenes using bacteria. Bull. Env. Contam. Toxicol. 31:105-111.

- 5) For abstracts of journal articles as cited in Chemical Abstracts:

Yamamoto, H., et al. 1982. Chronic toxicity and carcinogenicity test of 1,2,4-trichlorobenzene on mice by dermal painting. *Nara Igaku Zasshi*. 33:132-145. (Japan). From CAS:97:210121u.

- 6) For journal articles cited in secondary references:
format: citation of original journal article. "As cited in:"
citation of secondary reference.

example: Lovelock, J.E., et al. 1974. Halogenated hydrocarbons in and over the Atlantic. *Nature*. 247:194. As cited in: U.S. EPA. 1980. Ambient Water Quality Criteria for Carbon Tetrochloride. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. EPA 440/5-80-026.

- 7) For government documents with a specific author listed:

Kemp, H. T., et al. 1973. Water Quality Criteria Data Book. Effects of Chemicals on Aquatic Life. Volume 5. U.S. EPA, Office of Research and Development, Washington, D.C.

Robbins, John A. 1980. Sediments of Southern Lake Huron: Elemental Composition and Accumulation Rates. U.S. EPA, Office of Research and Development, Duluth, MN. EPA-600/3-80-080.

- 8) For government documents with an office listed as an author:

U.S. EPA. 1980. Proceedings of the Seminar on Biological Monitoring and its Use in the NPDES Permit Program. Office of Research and Development, Center for Environmental Research Information, Cincinnati, OH. EPA-600/9-80-026.

- 9) For citations from the Code of Federal Regulations (CFR):
format: Volume Number CFR Part Number. Section(s). Revised as of Date.

example: 49 CFR 107.001-002. Revised as of November 1, 1984.

REF.CAS-BEGIN and REF.CAS.END are fields which specify which volumes of the Chemical Abstracts are searched when the chemical evaluation is conducted. These fields are numerically searchable for updating purposes. Most records are researched beginning with Volume 56 (1967) of the Chemical Abstracts Service. A two decimal place real number is used to indicate the issue. For example, if volume 56 through volume 95 issue 6 are utilized, 56 and 95.06 are entered into the fields for the beginning and ending of the search, respectively.

APPENDIX B

On-Line Data Bases Searched

STN International File Coverage Period of File

Registry File	1967-present
CA File	1967-present

QSAR System File

PROPERTIES (estimation)	No time frame
AQUIRE	1972-1981
ECOTOX (estimation)	No time frame

Syracuse Research Corporation Env. Fate File

DATACLOG
(bibliographic file) -- to present
CHEMFATE (data value) -- to 1985
BIOLOG (bibliographic file)-- to present
CASLIST (file contains CAS registry
no., chemical formula,
and preferred chem.name)

APPENDIX D

Abbreviations Used in CESARS

D1. Abbreviations found in the fields for terrestrial species

Abbreviation	Complete Form
brd	Bird (domestic or lab)
bwd	wild bird species
chd	child
ckn	chicken
ctl	cattle
dck	duck
frg	frog
gpg	guinea pig
grb	gerbil
ham	hamster
hmn	human
inf	infant
mam	mammal (species unspecified)
mky	monkey
mus	mouse
ng	not given
pgn	pigeon
qal	quail
rbt	rabbit
sql	squirrel
tod	toad
trk	turkey
wmn	woman

D2. Abbreviations found in the terrestrial fields for dosing route

Abbreviation	Complete Form
ial	intraaural
iat	intraarterial
ice	intracerebral
icu	intracervical
idr	intradermal
idu	intraduodenal
ihl	inhalation
imm	immersion
imp	implant
ims	intramuscular
inj	injection (tissue unspecified)
ipc	intraplacental
ipl	intrapleural
ipr	intraperitoneal
irn	intrarenal
isp	intraspinal
itr	intratracheal
ivs	intravasinal
ivn	intravenous
mul	multiple route
ng	not given
ocu	ocular
orl	oral
rec	rectal
scu	subcutaneous
skn	skin

D3. Abbreviations found in Topic Area #2: Regulations

Abbreviation	Complete Form
AAA	Agricultural Adjustment Act
ACGIH	American Conference of Governmental Industrial Hygienists
CAA	Clean Air Act
CC	Ceiling Concentration
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
FFDA	Federal Food and Drug Administration
FFDCA	Federal Food, Drug and Cosmetic Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FSA	Federal Seed Act
FWPCA	Federal Water Pollution Control Act
FR	Federal Register
HMTA	Hazardous Materials Transportation Act
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PHSA	Public Health Service Act
RCRA	Resource Conservation and Recovery Act
STEL	Short Term Exposure Limit
TLV	Threshold Limit Value
TWA	Time Weighted Average

D4. Abbreviations found in Topic Area #16: Bioaccumulation/
Bioconcentration

Field	Abbreviation	Complete Form
BCF.TEXT (test type)	FLD FT IF MON REN ST	field type flow through intermittant flow monitoring data renewal static
BCF.TIS (tissue type examined)	BRN EVC FIL LIV ORG STO VIS WB OTH	brain eviscerated carcass fillet or muscle liver unidentified organ stomach visera or offal whole body other
BCF.TEXT (test condi- tions and results)	BAF BCF EM SS U-D	bioaccumulation factor bioconcentration factor ecological magnification factor steady state uptake and depuration

D5. Complete List of Abbreviations used in CESARS

Abbreviation	Complete Form
AAA	Agricultural Adjustment Act
ACGIH	American Conference of Governmental Industrial Hygienists
BAF	bioaccumulation factor
BCF	bioconcentration factor
brd	bird (domestic or lab)
BRN	brain
bwd	wild bird species
C.	centigrade
CAA	Clean Air Act
CAS	Chemical Abstract Service
C.C.	closed cup
cc	ceiling concentration
cc	cubic centimeters
C.C.C.	Cleveland closed cup
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
chd	child
C.I.	confidence interval
ckn	chicken
C.L.	confidence limits
CNS	central nervous system
C.O.C.	Cleveland open cup
ctl	cattle
cu m	cubic meter
CVS	cardiovascular system
CWA	Clean Water Act
dck	duck
D.O.	dissolved oxygen
DOT	U.S. Department of Transportation
ED	effective dose
E-L	embryo-larval stage
ELS	early life stage
EM	ecological magnification factor
EPA	U.S. Environmental Protection Agency
EVC	eviscerated carcass
F.	Fahrenheit
FFDA	Federal Food and Drug Administration
FFDCA	Federal Food Drug and Cosmetic Act
FIFRA	Federal Insecticide Fungicide and Rodenticide Act
FIL	Fillet or Muscle

FLD	field study
FR	Federal Register
frg	frog
FSA	Federal Seed Act
FT	flow-through
Abbreviation	Complete Form
FWPCA	Federal Water Pollution Control Act
gd	gestation day
gpg	guinea pig
grb	gerbil
ham	hamster
hmn	human
HMTA	Hazardous Materials Transportation Act
hr	hour
hrs	hours
ial	intraaural
IARC	International Agency for Research in Cancer
iat	intraarterial
ice	intracerebral
icu	intracervical
idr	intradermal
idu	intraduodenal
IF	intermittant flow
ihl	inhalation
imm	immersion
imp	implant
ims	intramuscular
inf	infant
inj	injection (tissue unspecified)
ipc	intraplacental
ipl	intrapleural
ipr	intraperitoneal
irn	intrarenal
isp	intraspinal
itr	intratracheal
ivs	intravasinal
ivn	intravenous
kg	kilogram
l	liter
LC	life cycle
LC50	The statistically determined concentration required to kill 50% of organisms tested following a single exposure.
LD50	The statistically determined dose required to kill 50% of organisms tested following the administration of a single dose of compound.
LDlo	lowest published lethal dose

LClo	lowest published lethal concentration
leu	leukocyte
LIV	liver
lug	lung
lym	lymphocyte
M	Molar
m	minute
mam	mammal (species unspecified)
mg	milligram
min	minute
mkg	monkey

Abbreviation	Complete Form
ml	milliliter
mar	mammary gland
mo	month
mol	mole
MON	monitoring data
mos	months
msl	muscle
mul	multiple routes
mus	mouse
ng	nanogram
NG	not given
NIOSH	National Institute for Occupational Safety and Health
nmol	nanomole
NOAEL	No Observed Adverse Effect Level
NOEL	No Observed Effect Level
N.O.S.	not otherwise specified (not isomer specific)
n.s.i.	no specific isomer
O.C.	open cup
ocu	ocular
OFL	offal
ORG	unidentified organ
orl	oral
OSHA	Occupational Safety and Health Administration
ovr	ovary
pc	peak concentration
PEL	Permissible Exposure Limit
pg	picogram
pgn	pigeon
PHSA	Public Health Service Act
PLC	partial life cycle
pmol	picomole
PNS	peripheral nervous system

ppb	parts per billion
pph	parts per hundred (percent)
ppm	parts per million
ppt	parts per trillion
ppth	parts per thousand
qal	quail
RBC	red blood cell
rbt	rabbit
RCRA	Resource Conservation and Recovery Act
rec	rectal
REN	renewal
SCE	sister chromatid exchange
scu	subcutaneous
S.D.	standard deviation
sec	second
skn	skin
sql	squirrel
SS	steady state
Abbreviation	Complete Form
ST	static test
STEL	Short Term Exposure Limit
STO	stomach
tc	toxic concentration
td	toxic dose
tes	testicle
TLV	Threshold Limit Value
tod	toad
trk	turkey
TWA	Time Weighted Average
U-D	uptake and depuration
ug	microgram
umol	micromole
VIS	viscera or offal
WB	whole body
WBC	white blood cell
wk	week
wmn	woman
%	percent

CESARS Standard References

- American Conference of Governmental Industrial Hygienists, Inc. (ACGIH). 1986. Documentation of the Threshold Limit Values for Substances in Workroom Air. 5th Edition. ACGIH, Cincinnati, OH.
- Amoore, J.E. and E. Hautala. 1983. "Odor as an Aid to Chemical Safety; Odor Thresholds Compared with Threshold Limit Values and Volatilities for 214 Industrial Chemicals in Air and Water Dilution." *Journal of Applied Toxicology*. 3:272-290.
- Becker, C.D. and T.O. Thatcher. 1973. Toxicity of Power Plant Chemicals to Aquatic Life. U.S. Atomic Energy Commission, WASH-1249 UC-11.
- Brown, A.W.A. 1978. *Ecology of Pesticides*. John Wiley and Sons, New York, NY.
- Callahan, Michael A., et al. 1979. Water-Related Environmental Fate of 129 Priority Pollutants. U.S. EPA, Office of Water and Waste Management, Washington, D.C. EPA-440/4-79-029a-b.
- Clayton, George D. and Florence E. Clayton (Eds.) 1982. *Patty's Industrial Hygiene and Toxicology*. 3rd Edition, Vol. 2a-c. John Wiley and Sons, New York, NY.
- Dawson, Gaynor W., et al. 1974. Determination of Harmful Quantities and Rates of Penalty for Hazardous Substances. Vol. III. U.S. EPA, Washington, D.C. EPA-440/9-75-00-5-c.
- Dean, John (Ed.). 1979. *Lange's Handbook of Chemistry*. 12th Edition. McGraw-Hill Book Co., New York, NY.
- Grayson M., et al. (Ed.). 1979. *Kirk-Othmer Encyclopedia of Chemical Technology*. 3rd Edition. John Wiley and Sons, New York, NY.
- Hansch, Corwin and Albert Leo. 1979. *Substituent Constants for Correlation Analysis in Chemistry and Biology*. 1979. John Wiley and Sons, New York, NY.
- Hawley, G.G., (Rev. by). 1981. *The Condensed Chemical Dictionary*. 10th Edition. Van Nostrand Reinhold Co., New York, New York.
- Hudson, R.H., et al. 1984. *Handbook of Toxicity of Pesticides to Wildlife*. Vol. 2. U.S. Department of the Interior, Fish and Wildlife Service. Report No. 153.
- Intermedia Priority Pollutant Guidance Documents. U.S. EPA.
- International Agency for Research on Cancer. IARC Monograph Series. "IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans." Lyon, France: IARC, 1971-1986.

- Johnson, Waynon W. and Mack T. Finley. 1965-1978. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. U.S. Fish and Wildlife Service, Washington, D.C.
- Kuhr, Ronald J. and H. Wyman Dorough. 1976. Carbamate Insecticides, Biochemistry and Toxicology. CRC Press, Inc., Cleveland, OH.
- Little, A.D. 1970. Water Quality Criteria Data Book. Vol. I and II. "Organic Chemical Pollution of Freshwater." U.S. EPA, Cambridge, MA. Contract No. 14-12-538.
- Lyman, Warren J., William F. Reehl, and David Rosenblatt. 1982. Handbook of Chemical Property Estimation Methods, Environmental Behavior of Organic Compounds. McGraw-Hill, Inc., New York, NY.
- Mabey, W. and T. Mill. 1978. "Critical Review of Hydrolysis of Organic Compounds in Water Under Environmental Conditions." Journal Phys. Chem. Ref. Data. Vol. 7, No. 2, pp. 383-415.
- Martin, Hubert, et al., (Ed). 1976. Insecticide and Fungicide Handbook for Crop Protection. 5th Edition. Blackwell Scientific Publishers.
- Mayer, F.L. and M.R. Ellersieck. 1986. Manual of Acute Toxicity: Interpretation and Data Base for 410 Chemicals and 66 Species of Freshwater Animals. U.S. Department of the Interior. Report No. 160.
- McEwen, F.L. and G.R. Stephenson. 1979. The Use and Significance of Pesticides in the Environment. John Wiley and Sons, New York, NY.
- McKee, J.E. and H.W. Wolf, (Ed.). 1963. Water Quality Criteria, 2nd Edition. California State Water Resources Control Board, OHEW.
- Meister, Richard T. (Ed.). 1982. Farm Chemicals Handbook. Meister Publishing Co., Willoughby, OH.
- Mullison, W.R., et al. 1983. Herbicide Handbook. 5th Edition. Weed Science Society of America, Champaign, IL.
- National Cancer Institute (U.S.). 1977-1980. "Bioassay for Possible Carcinogenicity." Carcinogenesis Tech. Rep. Ser. DHEW Publ. Bethesda, MD: U.S. Dept. of Health, Education, and Welfare, Public Health Service, National Institutes of Health.
- National Fire Protection Association. 1986. Fire Protection Guide on Hazardous Materials. 7th Edition. Batterymarch, Park, Quincy, MA.

- National Research Council (U.S.). 1977-1987. Drinking Water and Health. Volumes 1-7. Report of the Safe Drinking Water Committee, Advisory Center on Toxicology, Assembly of Life Sciences. Washington, D.C. National Academy Press.
- National Toxicology Program (U.S.). 1980-1986. Bioassay for Possible Carcinogenicity. Bethesda, MD.: U.S. Dept. of Health and Human Services, Public Health Service, National Institutes of Health.
- Packer, Kingsley. 1975. Nanogen Index, "A Dictionary of Pesticides." Nanogens International, Freedom, CA.
- Radding, S. and D. Lui. 1977. Review of the Environmental Fate of Selected Chemicals. EPA-560/5-77-003. Stanford Research Institute.
- Registry of Toxic Effects of Chemical Substances. U.S. Department of Health, Education and Welfare, Rockville, Maryland. April, 1987.
- Ross, R.H., et al. 1979. Chemicals Tested for Phytotoxicity. Volumes 1 and 2. U.S. Department of Energy. ORNL/EIS-155.
- Sax, N.I. 1984. Dangerous Properties of Industrial Materials. 6th Edition. Van Nostrand Reinhold Co., New York, NY.
- Schneider, Bernard A., (Ed.) 1966-1967. "Toxicology Handbook Mammalian and Aquatic Data. Book 1. Toxicology Data. U.S. EPA. Beltsville, MD.
- Sittig, Marshall. 1981. Handbook of Toxic and Hazardous Chemicals. Noyes Publications, Park Ridge, NJ.
- Smith, John H., et al. 1977. Environmental Pathways of Selected Chemicals in Freshwater Systems. Part I. Background and Experimental Procedures. SRI International, Menlo Park, CA. EPA 600/7-77-113, NTIS PB 274 548.
- Smith, John H., et al. 1978. Environmental Pathways of Selected Chemicals in Freshwater Systems. Part II. Laboratory Studies. SRI International , Menlo Park, CA. EPA-600/7-78-074, NTIS PB 288 511.
- U.S. EPA. 1980. Ambient Water Quality Criteria Documents. NTIS, Springfield, VA.
- U.S. EPA. 1976-1978. Chemical Hazard Information Profiles (CHIPS). Office of Pesticide and Toxic Substances, Washington, D.C. EPA-560/11-80-O11.
- Verschueren, K. 1983. Handbook of Environmental Data on Organic Chemicals. 2nd Edition. Van Nostrand Reinhold Co., New York, NY.
- Weast, Robert C., (Ed.). 1987. Handbook of Chemistry and Physics. 68th Edition. CRC Press, Inc., Cleveland, OH.

- Windholz, M., et al, (Ed.). 1983. The Merck Index. 10th Edition. Merck and Co., Inc., Rahway, NJ.
- Wiswesser, William J., (Ed.). 1976. Pesticide Index. 5th Edition. Entomological Society of America, College Park, MD.
- Worthing, Charles R., (Ed.). 1987. The Pesticide Manual. A World Compendium. 8th Edition. The British Crop Protection Council. BCPC Publications, London.
- U.S. International Trade Commission. 1985. Synthetic Organic Chemicals. Washington, D.C.

Additional References

- Angel, Jack E., (Pub.). 1987. Physicians' Desk Reference 41st Edition. Medical Economics Co.
- Chemical Regulation Reporter. Bureau of National Affairs, Washington, D.C.
- Cardarelli, Nater. 1976. Controlled Release Pesticides Formulations. CRC Press, Inc. Cleveland, OH.
- Code of Federal Regulations, "Title 40 (Protection of Environment)." Parts 19O-399. Title 49 (Transportation), Parts 1OO-177. National Archives and Records Service, General Services Administration.
- Cronin, Etain, Contact Dermatitis. 1980. Churchill Livingstone, Edinburgh.
- DHEW. 1977-1978 NIOSH Manual of Analytical Methods. 2nd Edition. Vol. 1-4. DHEW (NIOSH), Pub. No. 77-157-B.
- Edwards, C.A. 1976. Persistent Pesticides in the Environment. 2nd Edition. CRC Press, Inc. Cleveland, OH.
- Hann, Roy W., et al. 1977. Water Quality Characteristics of Hazardous Materials. Env. Eng. Div., Civil Eng. Dept., Texas A and M Univ., NOAA Acc. No. 78O13OO1, NTIS PB 285- 946.
- Horvath, A.L. 1982. Halogenated Hydrocarbons, Solubility- Miscibility With Water. Marcel Dekker, Inc. New York, NY.
- Kennedy, Maurice V., (Ed.). 1978. Disposal and Decontamination of Pesticides, ACS Symposium Series 73, American Chemical Society, Washington, D.C.
- Mackinson, Frank W., R. Scott Stricoff and Lawrence J. Partridge, Jr., (Ed.). 1981. Occupational Health Guidelines for Chemical Hazards. DHHS (NIOSH), Washington, D.C. Pub. No. 81-123.
- National Institute for Occupational Safety and Health. Criteria for a Recommended Standard for Occupational Exposure. U.S. Dept. of Health, Education and Welfare, Public Health Service, Center for Disease Control, Cincinnati, OH.
- Riegel, Emil Raymond. 1974. Riegel's Handbook of Industrial Chemistry. 7th Edition. Van Nostrand Reinhold Co., New York, NY.
- Schafer, Edward W. 1972. "The Acute Oral Toxicity of 369 Pesticides, Pharmaceuticals and Other Chemicals to Wild Birds." Toxicology and Applied Pharmacology. Vol. 21, pp. 315-330, 1972.

- Schneider, Bernard A., (Ed.). 1966-1967. Toxicology Data. U.S. EPA, Beltsville, MD.
- Shephard, Thomas H. 1986. Catalog of Teratogenic Agents. 5th Edition. Johns Hopkins Univer. Press, Baltimore, MD.
- Shreve, R. Norris and Joseph A. Brink, Jr. 1977. Chemical Process Industries. 4th Edition. McGraw-Hill Book Co. New York, NY.
- Sittig, Marshall, (Ed.). 1980. Pesticide Manufacturing and Toxic Materials Control Encyclopedia. 1980. Noyes Data Corp., Park Ridge, NJ.
- U.S. Department of Transportation. 1978. Chemical Hazard Response Information System (CHRIS). U.S. Coast Guard. Washington, D.C.
- U.S. EPA. TSCA Chemical Assessment Series, Office of Pesticide and Toxic Substances, Washington, D.C. EPA-56O/11-8O-OO8-O2O.

APPENDIX 6-6

REGULATORY STRATEGIES: THE DECISION PROCESS

REGULATORY STRATEGIES: THE DECISION PROCESS

INTRODUCTION

While designing the Clean Air Program, the Ministry re-examined the standard-setting process that has been in use, for more than a decade. Until recently, the regulation of stationary sources was based primarily on the source-specific design modelling for contaminant air concentrations at the point-of-impingement (POI). Some aspects of approval, abatement and enforcement were also based on these same POI design standards or on ambient air quality criteria. As the scientific understanding of complex airsheds has improved, the limitations of this regulatory approach have occasionally restricted our ability to aggressively regulate emissions to the air. In the past, while the Ministry has pursued every measure to limit emissions to the air, occasionally point-of impingement standards have been incorrectly interpreted, by the private-sector, as a licence to pollute.

Accordingly, there exists a need for chemical-specific regulatory strategies to move from source-specific, point-of-impingement air quality standards toward an approach more consistent with the program goals of: virtual elimination of toxic emissions and responsible stewardship for all emissions.

To adequately provide comprehensive chemical-specific regulatory strategies, it was concluded that the Ministry must be able to consider a wide variety of issues in order to protect the people of Ontario. Emissions to air may adversely affect our water or soil quality, or our plants, animals and food-chain. Multiple stationary sources may produce higher concentrations of a contaminant, in some geographic areas, through addition of each source's contribution. Relatively large total volumes of emissions from small sources throughout Ontario, long-range, trans-boundary transport of contaminants and smaller emissions of very persistent materials, may all lead to high background levels of chemicals in our environment. Airsheds that are highly loaded with contaminants may require additional regulation because of additive or synergistic effects. Alternately, some chemicals exhibit no known safe levels and so may require an analysis of the risk presented to the community; in this case, the substitution of other chemicals may provide a safer alternative. Mobile or very small sources may, in certain cases, inordinately add to airshed loadings. In such cases, multi-faceted strategies may be necessary, integrating and coordinating different Ontario regulations. Regulatory strategies will seek to minimize the risk presented by emissions to the air.

In summary, the previous approach, of applying POI design standards, can no longer adequately address the demands currently placed on our environment. Therefore, a new approach will be adopted to permit the development of comprehensive regulatory strategies, governing emissions to air.

THE NEW REGULATORY APPROACH

The Clean Air Program has aimed for a dual approach to regulation through the incorporation of protection on two planes or 'lines of defence'. The first plane is to be achieved through the application of control technology appropriate for the environmental Level-of-Concern classification, previously described. This regulatory action will provide a baseline consistent with the principles of virtual elimination and responsible stewardship.

As a second 'line of defence', the Clean Air Program incorporates many state of the art concepts to provide a comprehensive approach to assure the achievement and preservation of community air quality. In some cases, community air quality can be assured with qualitative (safe vs not-safe) analysis of anticipated emissions and ground-level concentrations (GLCs). Compliance can be tracked through performance conditions imposed on a C of A. For example, in circumstances such as might exist with a single provincial source of emission, this process can assure the protection of community air, without the need for the more costly development of province-wide, community air quality standards (AQS). In more complex cases, an AQS will need to be developed and administered for all points, within Ontario. In the most complex cases, the Ministry recognizes that only an integrated regulatory strategy for community air quality will be effective in assuring the air quality of our communities.

DEVELOPMENT OF AIR QUALITY STRATEGIES

Regulatory strategy development is resource intensive, time consuming and costly. Accordingly, a mechanism has been developed to permit prioritized decision-making with maximal Ministry resources directed preferentially to high priority issues, while maintaining the protection of our environment, on all issues. The process flow can be seen in the figure *Chemical-Specific Regulatory Strategies and Air Quality Standards (AQSSs)*.

The process includes three phases of consideration: priority assessment with some information collection, two levels of more detailed information collection (in-house collection as well as information collection by expert committees, if these are struck) and option analysis.

Priority Assessment:

The resources available to the Ministry for development of very detailed community air quality strategies are limited. Accordingly, an assessment of probable impact for a specific chemical will be used to direct strategy development into one of the following three priority streams. Tier 1 would consist of a qualitative, site-specific GLC assessment. Tier 2 would involve province-wide AQS and/or simple regulatory strategy development. Tier 3 would consist of a complex, integrated strategy development. Priority assessment may be based on the anticipated extent of impact (risk to the population) or the complexity of any expected environment - contaminant interaction. The assessment will suggest whether a province-wide strategy or a site specific analysis will be sufficient to protect the

community. It will normally be possible to determine priority (high, medium or low potential impact), for most chemicals, through the examination of relevant databases and the application of 'expert' judgement. Adequate, CESARS dossiers, provide a reasonable starting point for the priority setting exercise.

High priority contaminants will go on to be assessed and strategies developed as a first priority. Those contaminants with an intermediate potential for impact will be considered for strategy development as soon as resources permit. If there is an indication that a delay may be encountered in the development of a general regulatory strategy, then the safety of any expected contaminant release and the resultant ground-level concentration (GLC) will be assessed for safety qualitatively, as an interim measure. For these compounds, Ministry resources will be applied to the development of an AQS as soon as possible. Low priority contaminants will have community air protected solely through a qualitative, site-specific assessment of the expected GLC. For those contaminants where the assessment of a GLC is required, the information from the CESARS dossier and other databases can be combined with details from other, recognized jurisdictions to make judgements of environmental safety of the expected GLC. Conditions can be applied to the granting of Certificates of Approval to ensure ongoing compliance with such judgements.

Detailed Information Collection and Regulatory Option Analysis:

For chemicals requiring the development of community air quality standards and more complex regulatory strategies, Ministry environmental experts will often be able to collect sufficient information to suggest the regulatory options available; the same information will be adequate for the Ministry to propose an appropriate strategy to ensure community air quality. Usually, this will consist solely of an AQS.

Where community air quality standards are to be developed, criteria for diverse environmental adverse effects will again be developed in detail. The end-points may include adverse effects on: health, vegetation, soil, aquatic biota and materials. Sufficient additional information will be collected on environmental parameters to propose an interim AQS and a basic strategy for the control of environmental emissions to air. This information may include a consideration of the existing ambient background concentration of the contaminant, the impact of emissions to the air on other media and in some cases include risk balancing. Where available, multi-media criteria will be included in regulatory option analysis. Reduction of exposure from other media could be identified via this process. If unavailable, interim measures will be taken.

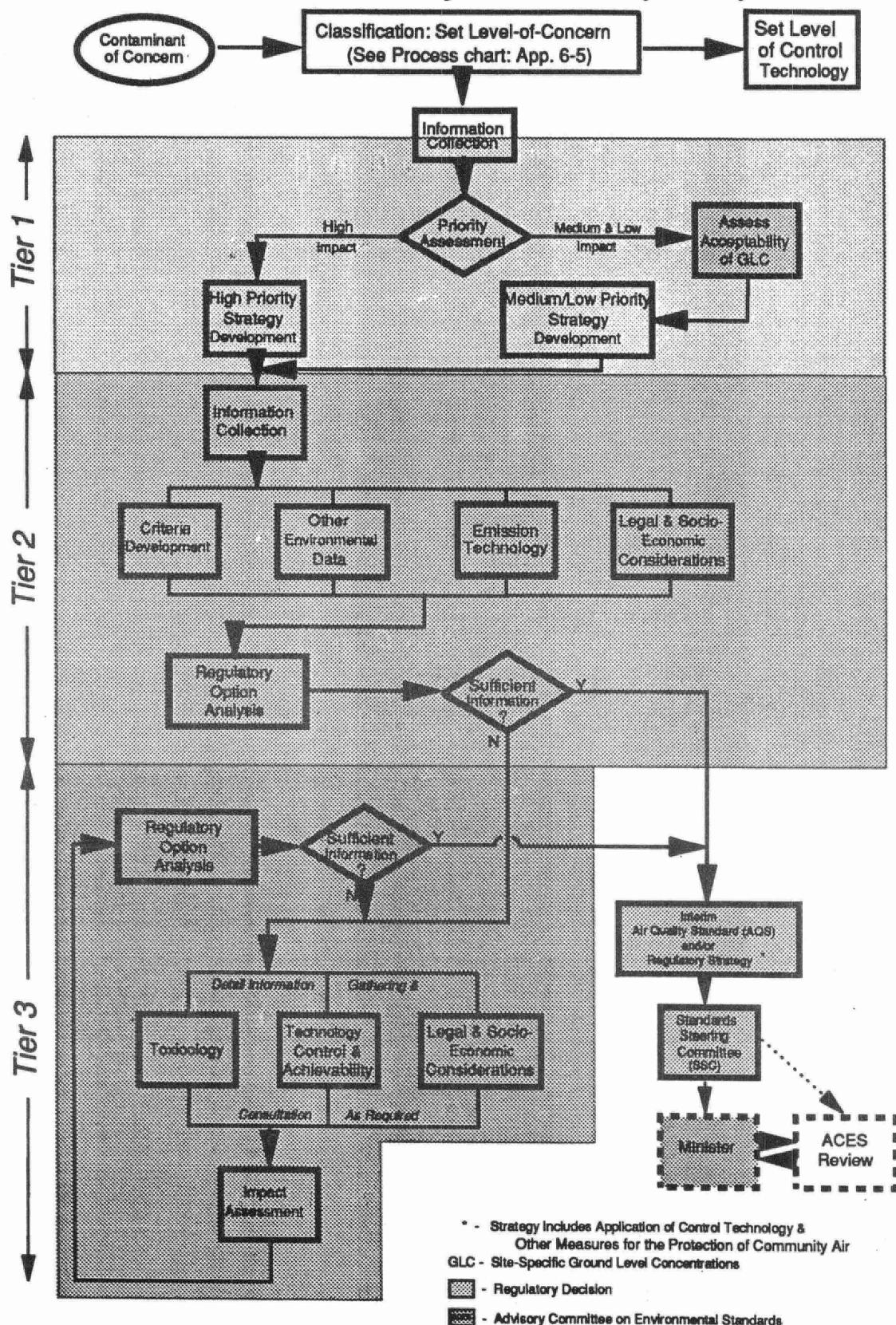
For some chemicals, it will be more difficult to develop community air strategies, than to purely generate an AQS. These chemicals may be prominent in the environment, or have many diverse sources, or very complicated toxicology. They may express extensive interaction with other chemicals or produce complex indirect effects. In these cases, a more resource intensive approach may be required. More detailed information collection will likely be required, and may involve a variety of experts from outside of the Ministry. Regulatory strategy options will likely be more complex and may indicate the need to coordinate activities with other regulatory programs, or may extend to the development of

Province-wide, remedial strategies for community air. For these materials, consultative committees will be struck, as required, to provide the input necessary to develop the regulatory options available to the Ministry. Risk analysis techniques will provide the primary basis for the critical assessment of regulatory options and the selection of the most efficacious options available to the Ministry.

Proposed (Interim) Air Quality Standard and/or Regulatory Strategy

Following the selection of a regulatory strategy designed to ensure community air quality, the proposal will immediately be applied as an interim strategy. The interim proposal will then be sent to the Ministry's Standards Steering Committee and if appropriate, for review by the Minister's Advisory Committee on Environmental Standards (ACES). Both expert review as well as stakeholder and public consultation will occur, at ACES. Following acceptance by the Minister, the strategy will be adopted as a Ministry policy or be sent to the Registrar of Regulations for more formal action.

Chemical-Specific Regulatory Strategies and Air Quality Standards (AQSs):



APPENDIX 6-7

INTERIM AIR QUALITY STANDARDS



APPENDIX 6-7

INTERIM AIR QUALITY STANDARDS

The tables of this appendix represent the current air quality limits which the Ministry uses for abatement purposes. While the regulatory strategies development process outlined in Appendix 6-6 is expected to yield improvements over many of these values, it is necessary to provide standards which can be used to maintain the existing degree of environmental protection in the interim.

As an aid to interpretation, all averages are arithmetic unless otherwise specified, and the standards refer to the specific element or compound cited unless specific note is made of an "equivalent pollutant" (i.e., the phrase "as pollutant X") to which amounts must be normalized. This is done using the following relationship:

$$Y = C_{act} \times FW_{equiv} / FW_{act}$$

where: Y = value to be compared to standard
 C_{act} = concentration of actual compound
 FW_{equiv} = formula weight of element or compound standard is expressed in terms of
 FW_{act} = formula weight of actual compound

The term formula weight in this context may mean molecular weight, atomic weight or either of these terms adjusted for the atomic count of the critical element in the "actual" compound. For example, 10 $\mu\text{g}/\text{m}^3$ of arsenic trioxide (As_2O_3 , MW = 197.8414 grams/gram-mole) expressed as arsenic element (As, AW = 74.9216) would translate as:

$$\begin{aligned} C_{As} &= (10 \mu\text{g}/\text{m}^3) \times (2 \times 74.9216) / (197.8414) \\ &= 7.6 \mu\text{g}/\text{m}^3 \text{ as As} \end{aligned}$$

The atomic weight of arsenic is multiplied by the number of atoms of arsenic in the chemical compound in order to come up with the formula weight. Where two compounds are involved rather than an element and a compound, similar considerations may be invoked. Consider 10 $\mu\text{g}/\text{m}^3$ of dimethyl disulphide ($(\text{CH}_3)_2\text{S}_2$, MW = 94.1894 grams/gram-mole) as a component of total reduced sulphur, expressed as hydrogen sulphide (H_2S , MW = 34.0758). Note that there are two sulphur atoms in dimethyl sulphide, and only one in hydrogen sulphide. The equivalence works out to:

$$\begin{aligned} C_{TRS \text{ as } H_2S} &= (10 \mu\text{g}/\text{m}^3) \times (2 \times 34.0758) / (94.1894) \\ &= 7.2 \mu\text{g}/\text{m}^3 \text{ as H}_2\text{S} \end{aligned}$$

Tables 1, 2 and 5 are generally to be used in assessing applications for approval as well as for comparison to actual observations. Tables 3 and 4 are intended for comparison to actual measurements.

In cases where pollutants have standards set for several averaging periods, all are to be met. The following legend pertains to the column headed "Additional Notes" and the codes presented therein.

- A - This contaminant also has a standard based on an annual averaging period. Consult Table 5 to find the value.
- D - This contaminant also has a standard based on a 24-hour averaging period. Consult Table 1 to find the value.
- G - This value is a geometric mean for the relevant averaging period.
- H - This contaminant also has a standard based on a one-hour averaging period. Consult Table 2 to find the value.
- M - This contaminant also has a standard based on a 30-day averaging period. Consult Table 4 to find the value.
- S - This contaminant has differing standards depending upon whether it is the growing or non-growing season. The growing season for southern Ontario is defined as April 1 to September 30; for the Ministry's Northeastern and Northwestern Regions, it is defined as May 1 to September 30.
- Z - There is an additional requirement that, where PCDDs are emitted in mixtures with polychlorinated dibenzofurans (PCDFs), the following relationships must be satisfied:

$$(a / 450) + (b / 22,500) \leq 1 ; (c / 30) + (d / 1,500) \leq 1$$

where a = PCDD concentration in air for a half-hour averaging time

 b = PCDF concentration in air for a half-hour averaging time

 c = PCDD concentration in air for an annual averaging period

 d = PCDF concentration in air for an annual averaging period

and all of a, b, c and d are in units of pg/m³ (picograms per cubic metre)

INTERIM AIR QUALITY STANDARDS

TABLE 1: Pollutants With Standards Using A 24 Hour Averaging Period

Contaminant Name	Contaminant	24 Hour		Additional Notes
		Code or CAS No.	Air Quality Standard ($\mu\text{g}/\text{m}^3$)	
A Acetic acid		64-19-7	2500	
Acetone		67-64-1	48000	
Acetophenone		98-86-2	850	H
Acetylene		74-86-2	56000	
Acrolein		107-02-8	23.5	
Acrylamide		79-06-1	15	
Acrylonitrile		107-13-1	100	
Alkyltoluene sulphonamide, n-			120	
Aluminum oxide		7429-90-5	120	
Ammonia		7664-41-7	3600	
Ammonium chloride		12125-02-9	120	
Amyl acetate, iso-			53200	
Amyl acetate, n-			53200	
Amyl acetate, secondary			66500	
Antimony		7440-36-0	25	
Arsenic		7440-38-2	0.3	
Arsine		7784-42-1	5	
Asbestos		1332-21-4	1.5	
B Barium - total water soluble		7440-39-3	10	
Benzene		71-43-2	In Progress	
Benzothiazole		95-16-9	70	
Benzoyl chloride		98-88-4	125	
Benzo(a)pyrene		50-32-8	0.0015	A
Beryllium		7440-41-7	0.01	
Borax			33	
Boric acid			33	
Boron		7440-42-8	120	
Boron tribromide		10294-33-4	35	
Boron trichloride		10294-34-5	35	
Boron trifluoride		7637-07-2	2	
Bromacil		314-40-9	10	
Bromine		7726-95-6	20	
Butanol, iso-		78-83-1	655	
Butanol, n-		71-36-3	770	H
Butanol, tertiary		75-65-0	30300	
Butyl acetate, n-		123-86-4	248	H
Butyl acrylate		141-32-2	120	
Butyl stearate		123-95-5	120	
C Cadmium		7440-43-9	2	
Calcium carbide		75-20-7	10	

INTERIM AIR QUALITY STANDARDS - TABLE 1 (continued)

Contaminant Name	24 Hour		
	Contaminant	Air Quality Code or CAS No.	Standard ($\mu\text{g}/\text{m}^3$) Additional Notes
Calcium cyanide (as total salt)	592-01-8	120	
Calcium hydroxide	1305-62-0	13.5	
Calcium oxide	1305-78-8	10	
Captan	133-06-2	25	
Carbon black	1333-86-4	10	
Carbon disulphide	75-15-0	330	
Carbon tetrachloride	56-23-5	600	
Chloramben	133-90-4	120	
Chlordane	57-74-9	5	
Chlorine	7782-50-5	150	
Chlorine dioxide	10049-04-4	30	
Chlorodifluoromethane (Freon 22)	75-45-6	350000	
Chloroform	67-66-3	500	
Chromium - di-, tri- and hexavalent forms	7440-47-3	1.5	
Citric acid	77-92-9	120	H
Coal tar pitch volatiles - soluble fraction	8007-45-2	1	A
Cobalt		0.1	
Copper	7440-50-8	50	
Cresol (mixed isomers)	1319-77-3	75	
Cyanogen chloride	506-77-4	12	
Cyclo sol 63		5000	
Cyclohexane	110-82-7	100000	
D Dalapon sodium salt	127-20-8	50	
Decaborane	17702-41-9	25	
Decene, 1-	872-05-9	60000	
Detergent enzyme (Subtilisin)	1395-21-7	0.06	
Diacetone alcohol	123-42-2	335	
Diazinon	333-41-5	3	
Diborane	19287-45-7	10	
Dibutyl phthalate (DBP)	84-74-2	50	
Dibutyltin dilaurate	77-58-7	30	
Dicapryl phthalate	131-15-7	120	
Dichloro-1,1,2,2,-tetrafluoro ethane, 1,1- (Freon 114)	1320-37-2	700000	
Di-2-ethylhexyl phthalate (DEHP)	117-81-7	50	
Diethyl phthalate (DEP)	84-66-2	125	
Diethylene glycol monobutyl ether	112-34-5	65	
Diethylene glycol monobutyl ether acetate	124-17-4	85	
Diethylene glycol monoethyl ether	111-90-0	273	
Diethylene glycol monoethyl ether acetate	112-12-5	1800	
Difluorodichloromethane (Freon 12)	75-71-8	500000	

INTERIM AIR QUALITY STANDARDS - TABLE 1 (continued)

TABLE 1: Pollutants With Standards Using A 24 Hour Averaging Period

Contaminant Name		Contaminant Code or CAS No.	Air Quality Standard ($\mu\text{g}/\text{m}^3$)	24 Hour Additional Notes
Dihexyl phthalate (DHP)		84-75-3	50	
Diisobutyl ketone		108-83-8	159	H
Dimethyl ether		115-10-6	2100	
Dimethyl methylphosphonate		756-79-6	875	
Dimethyl phthalate (DMP)		131-11-3	125	
Dimethyl-1,3-diamino propane, n,n-		109-55-7	20	
Dimethylacetamide, n,n-			300	
Diethyl phthalate		117-84-0	50	
Dioxane		123-91-1	3500	
Dioxolane		646-06-0	10	
Diphenylamine		122-39-4	17.5	
Diquat dibromide - respirable		85-00-7	0.032	
Diquat dibromide - total in ambient air		85-00-7	0.16	
Dodecyl benzene sulphonic acid		1886-81-3	120	
Dodine		24391-00-3	10	
Droperidol		548-73-2	1	
E Ethyl ether		60-29-7	30000	
Ethyl-3-ethoxy propionate		763-69-9	50	
Ethylanthraquinone, 2-		84-51-5	10	
Ethylene		74-85-1	40	
Ethylene dichloride		10-76-2	400	
Ethylene glycol		107-21-1	12700	
Ethylene glycol butyl ether (Butyl cellosolve)		111-76-2	2400	
Ethylene glycol butyl ether acetate		1121-71-2	3250	
Ethylene glycol dinitrate		628-96-6	3	
Ethylene glycol ethyl ether (Cellosolve)		110-80-5	380	
Ethylene glycol ethyl ether acetate		111-15-9	540	
Ethylene glycol monohexyl ether		112-25-4	2500	
Ethylene oxide		75-21-8	5	
Ethylenediaminetetraacetic acid		60-00-4	120	
F Fentanyl citrate		990-73-8	0.02	
Ferric oxide		1309-37-1	25	
Fluorides (as HF) - gaseous, during growing season		7664-39-3	0.86	S
Fluorides (as HF) - total, during growing season		7664-39-3	1.72	S
Fluorides (as HF) - total, during nongrowing season		7664-39-3	3.44	S
Fluorinert 3M-FC-70			120	
Formic acid		64-18-6	500	
Furfuryl alcohol		98-00-0	1000	
G Glutaraldehyde		111-30-8	14	H
H Haloperidol		52-86-8	0.1	

INTERIM AIR QUALITY STANDARDS - TABLE 1 (continued)

TABLE 1: Pollutants With Standards Using A 24 Hour Averaging Period

Contaminant Name	Contaminant Code or CAS No.	24 Hour Air Quality Standard ($\mu\text{g}/\text{m}^3$)		Additional Notes
		Contaminant Code or CAS No.	Air Quality Standard ($\mu\text{g}/\text{m}^3$)	
Hexachlorocyclopentadiene	77-47-4	2		
Hexamethyl disilazane	999-97-3	2		
Hexamethylene diisocyanate monomer	822-06-0	0.5		
Hexamethylene diisocyanate trimer	4035-89-6	1		
Hexane	110-54-3	12000		
Hexylene glycol	107-41-5	12000		
Hydrogen chloride	7647-01-0	40		
Hydrogen cyanide	74-90-8	575		
Hydrogen peroxide	7722-84-1	30		
I Iron - metallic	15438-31-0	4		
Isobutyl acetate	110-19-0	412		
Isopropyl acetate	108-21-4	500		
L Lead	7439-92-1	5	M	
Lindane (Hexachlorocyclohexane)	58-89-9	5		
Lithium - other than hydrides		20		
Lithium hydrides	7580-67-8	2.5		
M Magnesium oxide	1309-48-4	120		
Malathion	121-75-5	120		
Maleic anhydride	108-31-6	30		
Manganese compounds (as Mn) - including permanganates	7439-96-5	2.5		
Mercapto benzo thiazo disulphide	120-78-5	120		
Mercury	7439-97-6	2		
Mercury (as Hg) - alkyl compounds		0.5		
Metaldehyde	108-62-3	120		
Methacrylic acid	79-41-4	2000		
Methane diphenyl diisocyanate	101-68-8	1		
Methanol (Methyl alcohol, Wood alcohol)	67-56-1	28000		
Methoxychlor	72-43-5	120		
Methyl bromide	74-83-9	1350		
Methyl chloride	74-87-3	7000		
Methyl ethyl ketone peroxide	1338-23-4	80	H	
Methyl isobutyl ketone	108-10-1	1200		
Methyl methacrylate	80-62-6	860		
Methyl salicylate	119-36-8	100		
Methyl-2-hexanone, 5-	110-12-3	160		
Methylal	109-87-5	6200		
Methylcyclopentadienyl manganese tricarbonyl (MMT)	12108-13-3	10		
Methylene chloride	75-09-2	1765		
Methylene dianiline	107-77-9	10		
Methylene-bis-2-chloroaniline, 4,4-	101-14-4	10		

INTERIM AIR QUALITY STANDARDS - TABLE 1 (continued)

TABLE 1: Pollutants With Standards Using A 24 Hour Averaging Period

Contaminant Name		Contaminant Code or CAS No.	Air Quality Standard ($\mu\text{g}/\text{m}^3$)	24 Hour Additional Notes
Methyl-n-amyl ketone		110-43-0	4600	
Miconazole nitrate			5	
Milk powder			20	
Mineral spirits			10000	
Molybdenum		7439-98-7	120	
Monomethyl amine		74-89-5	25	
Naphthalene		91-20-3	22.5	
Naphthol, alpha-		90-15-3	100	
Nickel		7440-02-0	2	
Nickel carbonyl		13463-39-3	0.5	
Nitric acid		7697-37-2	35	
Nitrilotriacetic acid		18662-53-8	120	
Nitrogen oxides (as Nitrogen dioxide)		10102-44-0	200	H
Nitroglycerin		55-63-0	3	
Nitrous oxide		10024-97-2	9000	
O Octane		111-65-9	15300	
Octene, 1-		25377-83-7	50000	
Oxalic acid		144-62-7	25	
P Palladium - water soluble compounds		7657-10-1	10	
Paraquat dichloride - respirable		1910-42-5	0.003	
Paraquat dichloride - total in ambient air		1910-42-5	0.015	
Particulate matter - suspended (<44 μm aero. diam.)			120	A
Penicillin		1406-05-9	0.1	
Pentaborane		19624-22-7	1	
Pentachlorophenol		87-86-5	20	
Perchloroethylene		127-18-4	4000	
Phenol		108-95-2	100	
Phosgene		75-44-5	45	
Phosphine		7803-51-2	10	
Phosphoric acid (as P2O5)		7664-38-2	120	
Phosphorus oxychloride		10025-87-3	12	
Phosphorus pentachloride		10026-13-8	10	
Phthalic anhydride		85-44-9	120	
Pimozide		2062-78-4	1	
Platinum - water soluble compounds		7440-06-4	0.2	
Polybutene-1-sulphone			120	
Polychlorinated dibenzo-p-dioxins (PCDDs)			0.00015	A, Z
Polychlorinated biphenyls (PCBs)		1336-36-3	0.15	A
Polychloroprene		25267-15-6	500	
Potassium cyanide		151-50-8	120	

INTERIM AIR QUALITY STANDARDS - TABLE 1 (continued)

TABLE 1: Pollutants With Standards Using A 24 Hour Averaging Period

Contaminant Name	Contaminant Code or CAS No.	Air Quality Standard ($\mu\text{g}/\text{m}^3$)	24 Hour Additional Notes
Potassium hydroxide	1310-58-3	14	
Potassium nitrate	7757-79-1	120	
Propanol, iso- (Isopropyl alcohol, Isopropanol)	67-63-0	24000	
Propanol, n- (Propyl alcohol)	71-23-8	16000	
Propionaldehyde	123-38-6	2.5	
Propylene dichloride	78-87-5	2400	
Propylene glycol	57-55-6	120	
Propylene glycol methyl ether	107-98-2	30000	
Propylene glycol monomethyl ether acetate	108-65-6	5000	
Propylene oxide	75-56-9	4500	
Pyridine	110-86-1	150	
S Selenium	7782-49-2	10	
Silane	7803-62-5	150	
Silica - respirable, under 10 μm aerodynamic diameter		5	
Silver	7440-22-4	1	
Sodium bisulphite	7631-90-5	120	
Sodium chlorate	7775-09-9	6	
Sodium chlorite	7758-19-2	20	
Sodium cyanide	143-33-9	120	
Sodium hydroxide	1310-73-2	10	
Stannous chloride (as Sn)		10	
Strontium	7440-24-6	120	
Strontium carbonate	1633-05-2	120	
Strontium hydroxide	18480-07-4	120	
Strontium oxide	1314-11-0	120	
Styrene	100-42-5	400	
Sulphamic acid		120	
Sulphur dioxide	7446-09-5	275	A,H
Sulphur hexafluoride	2551-62-4	600000	
Sulphuric acid	7664-93-9	35	
T Talc - fibrous	14807-96-6	2	
Tellurium - excluding hydrogen telluride	13494-80-9	10	
Tetrabutylurea		10	
Tetrahydrofuran	109-99-9	93000	
Tetramethyl thiuram disulphide		10	
Thiourea	62-56-6	20	
Tin	7440-31-5	10	
Titanium	7440-32-6	120	
Tolmetin sodium		5	
Toluene	108-88-3	2000	

INTERIM AIR QUALITY STANDARDS - TABLE 1 (continued)

TABLE 1: Pollutants With Standards Using A 24 Hour Averaging Period

Contaminant Name	24 Hour		
	Contaminant	Air Quality	Additional
	Code or CAS No.	Standard ($\mu\text{g}/\text{m}^3$)	Notes
Toluene diisocyanate	584-84-9	0.5	
Trichlorobenzene, 1,2,4-	120-82-1	400	
Trichloroethane, 1,1,1- (Methyl chloroform)	71-55-6	115000	
Trichloroethylene	79-01-6	28000	
Trichlorofluoromethane		6000	
Trifluorotrichloroethane	76-13-1	800000	
Trimethylbenzene, 1,2,4-	2551-13-7	1000	
Trimethylol propane	77-99-6	1250	
Tripropyltin methacrylate		1	
V Vanadium	7440-62-2	2	
Vinyl chloride	75-01-4	1	A
Vinylidene chloride (1,1-Dichloroethene)	75-35-4	35	
W Warfarin	81-81-2	10	
Whey powder		120	
X Xylenes	1330-20-7	2300	
Z Zinc	7440-66-6	120	
Zinc chloride		10	

TABLE 2: Pollutants With Standards Using One Year Averaging Periods

Contaminant Name	Annual Average		
	Contaminant	Air Quality	Additional
	Code or CAS No.	Standard ($\mu\text{g}/\text{m}^3$)	Notes
Benzo(a)pyrene	50-32-8	0.0003	
Coal tar pitch volatiles (soluble fraction)	8007-45-2	0.2	
Particulate matter - suspended (<44 μm aero. diam.)		60	G
Polychlorinated biphenyls	1336-36-3	0.035	
Polychlorinated dibenzo-p-dioxins (PCDDs)		0.00003	Z
Sulphur dioxide	7446-09-5	55	
Vinyl chloride	75-01-4	0.2	

INTERIM AIR QUALITY STANDARDS

Table 3: Pollutants With Standards Using One Hour Averaging Periods

Contaminant Name	Contaminant	1 Hour		Additional Notes
		Code or CAS No.	Air Quality Standard ($\mu\text{g}/\text{m}^3$)	
A Acetophenone		98-86-2	1167	D
B Biphenyl		92-52-4	60	
Butanol, n-		71-36-3	15000	D
Butanone, 2- (Methyl ethyl ketone)		78-93-3	31000	
Butyl acetate, n-		123-86-4	605	D
C Carbon monoxide		630-08-0	36200	
Chlorobenzene		108-90-7	3500	
Citric acid		77-92-9	300	D
D Decane, n-		124-18-5	60000	
Dibutyl amine		111-92-2	2645	
Dichlorobenzene, ortho-		95-50-1	30500	
Diethyl amine		109-89-7	2910	
Di-isobutyl ketone		108-83-8	649	D
Dimethyl amine		124-40-3	1840	
Dimethyl disulphide		624-92-0	40	
Dimethyl sulphide		75-18-3	30	
E Ethanol		64-17-5	19000	
Ethyl acetate		141-78-6	19000	
Ethyl acrylate		140-88-5	4.5	
Ethyl benzene		100-41-4	4000	
Ethyl hexanol, 2-		104-76-7	600	
F Formaldehyde		50-00-0	65	
Furfural		98-01-1	1000	
G Glutaraldehyde		111-30-8	35	D
H Hydrogen bromide		10035-10-6	668	
Hydrogen sulphide		7783-06-4	30	
I Isopropyl benzene		98-82-8	100	
M Mercaptans (as Methyl mercaptan)		74-93-1	20	
Methyl acrylate		96-33-3	4	
Methyl ethyl ketone peroxide		1338-23-4	200	D
Methyl-2-pyrrolidone, n-		872-50-4	40000	
N Nitrogen oxides (as Nitrogen dioxide)		10102-44-0	400	D
O Oleic acid		112-80-1	5	
Ozone		10028-15-6	165	
P Propionic acid		79-09-4	100	
Propionic anhydride (as Propionic acid)		123-62-6	100	
R Reduced sulphur compounds (as Hydrogen sulphide)			40	
S Sulphur dioxide		7446-09-5	690	A,D
T Trimethyl amine		75-50-3	0.5	

INTERIM AIR QUALITY STANDARDS

TABLE 4: Pollutants With Standards Using Ten Minute Averaging Periods

Contaminant Name	Contaminant Code or CAS No.	10 Minute Air Quality Standard ($\mu\text{g}/\text{m}^3$)		Additional Notes
		Air Quality Standard ($\mu\text{g}/\text{m}^3$)	Additional Notes	
Butanol, iso-	78-83-1	2640	D	
Butanol, n-	71-36-3	3100	D,H	
Butyl acetate, n-	123-86-4	1000	D,H	
Diacetone alcohol	123-42-2	1350	D	
Diethylene glycol monoethyl ether	111-90-0	1100	D	
Ethyl-3-ethoxy propionate	763-69-9	200	D	
Ethylene glycol butyl ether (Butyl cellosolve)	111-76-2	500	D	
Ethylene glycol butyl ether acetate	1121-71-2	700	D	
Ethylene glycol ethyl ether (Cellosolve)	110-80-5	1100	D	
Ethylene glycol ethyl ether acetate	111-15-9	300	D	
Isobutyl acetate	110-19-0	1660	D	
Isopropyl acetate	108-21-4	2000	D	
Methyl-2-hexanone, 5-	110-12-3	630	D	
Monochlorobenzene	108-90-7	4500	H	
Naphthalene	91-20-3	50	D	
Octane	111-65-9	61800	D	
Propionaldehyde	123-38-6	10	D	
Propylene glycol methyl ether	107-98-2	121000	D	
Pyridine	110-86-1	80	D	

TABLE 5: Pollutants With Standards Using Unusual Averaging Periods or Units of Measure

Contaminant Name	Contaminant Code or CAS No.	Air Quality Standard	Units	
Asbestos (fibres > 5 μm in length)	1332-21-4	0.04	Fibres/cm ³	
Carbon monoxide (8 hour averaging period)	630-08-0	15700	$\mu\text{g}/\text{m}^3$	
Dustfall (30 d averaging period)		7	g/m^2	
Dustfall (annual averaging period)		4.6	g/m^2	
Fluoridation - total (growing season, 30 d average)	7664-39-3	40	$\mu\text{g}/100\text{cm}^2$	
Fluoridation - total (nongrowing season, 30 d average)	7664-39-3	80	$\mu\text{g}/100\text{cm}^2$	
Fluorides (as HF) - gaseous (growing season, 30 d avg)	7664-39-3	0.34	$\mu\text{g}/\text{m}^3$	
Fluorides (as HF) - total (growing season, 30 d avg)	7664-39-3	0.69	$\mu\text{g}/\text{m}^3$	
Fluorides (as HF) - total (nongrowing season, 30 d avg)	7664-39-3	1.38	$\mu\text{g}/\text{m}^3$	
Fluorides in forage (30 d average)	7664-39-3	80	ppm (dry wt)	
Fluorides in forage (60 d average)	7664-39-3	60	ppm (dry wt)	
Fluorides in forage (avg growing season 30d avg values)	7664-39-3	35	ppm (dry wt)	
Lead (30 d averaging period)	7439-92-1	3	$\mu\text{g}/\text{m}^3$	
Lead (30 d averaging period, geometric mean)	7439-92-1	2	$\mu\text{g}/\text{m}^3$	
Lead in dustfall	7439-92-1	0.1	g/m^2	

APPENDIX 7

EMISSION LIMITS AND APPROVALS

APPENDIX 7-1
EMISSION LIMITS

APPENDIX 7-1

EMISSION LIMITS

In the final draft of the regulation, this appendix will include a list of emission limits obtained by the Ministry from other jurisdictions. To date, copies of the legislation from the federal level in 24 countries, and the state and province level in the United States and Canada has been obtained and is in the process of being analyzed.

In progress reports, the contractor hired to obtain the information now under review noted that there is a reasonable breadth of data on "criteria pollutants" (sulphur dioxide, nitrogen oxides, carbon monoxide, lead, volatile organic compounds, suspended particulate matter, ozone and reduced sulphur compounds). However, regulated levels for non-criteria pollutants are sparse. Many jurisdictions have taken a case-by-case approach. In many of the United States, regulators have modified the LAER and BACT requirements to derive a "T-BACT" (T standing for "toxics"). The Bush, Senate and Congressional proposals for amendments to the U.S. Clean Air Act include similar approaches, termed MACT (for "Maximum Achievable Control Technology") in President Bush's original proposal.

Additional information is potentially available at the air quality management district level in the U.S., and at the regional/provincial/territorial level in other of the 24 countries surveyed to date. Along with reviews of the case-specific evaluations being performed in the U.S., such an investigation will yield additional emission standards which may be implemented without requiring applicants to perform Technology Reviews and Ministry staff to review and approve them. Where chemical-specific control performance data is lacking currently, emission limits may be set on the basis of broad pollutant categories (e.g., particulate matter or volatile organic compounds) with conditions requiring the owner or operator of a source to provide performance test results sufficient to establish chemical-specific limits by a specified deadline.

It is proposed that, as emission standards are to be set on a source-specific basis where the source is defined in a narrow sense (as a discrete portion of a facility or establishment - see glossary) the U.S. system of Source Classification Codes (SCC) be used in assigning emission standards. A copy of the listing of assigned SCCs is appended. The final schedule of emission limits would state the SCC and description of the process controlled, the contaminants emitted after control, and the emission limits for each with units of either:

- kg pollutant emitted per Mg product output,
- kg pollutant emitted per Mg raw material input, or
- kg pollutant emitted per GJ heat input.

SOURCE CLASSIFICATION CODES

(S.C.C.)

EXTERNAL COMBUSTION BOILERS - ELECTRIC GENERATION

- 4911

Anthracite Coal

- 1-01-001-01 - Pulverized Coal
- 1-01-001-02 - Traveling Grate Stokers

Bituminous Coal

- 1-01-002-01 - Pulverized Coal: Wet Bottom
- 1-01-002-02 - Pulverized Coal: Dry Bottom
- 1-01-002-03 - Cyclone
- 1-01-002-04 - Spreader Stoker
- 1-01-002-05 - Traveling Grate (Overfeed) Stoker
- 1-01-002-12 - Pulverized Coal: Dry Bottom
(Tangential Firing)
- 1-01-002-17 - Atmospheric Fluidized Bed

Subbituminous Coal

- 1-01-002-21 - Pulverized Coal: Wet Bottom
- 1-01-002-22 - Pulverized Coal: Dry Bottom
- 1-01-002-23 - Cyclone
- 1-01-002-24 - Spreader Stoker
- 1-01-002-25 - Traveling Grate (Overfeed) Stoker
- 1-01-002-26 - Pulverized Coal: Dry Bottom
(Tangential Firing)

Lignite

- 1-01-003-01 - Pulverized Coal
- 1-01-003-02 - Pulverized Coal: Tangential Firing
- 1-01-003-03 - Cyclone
- 1-01-003-04 - Traveling Grate (Overfeed) Stoker
- 1-01-003-06 - Spreader Stoker

Residual Oil

- 1-01-004-01 - Grade 6 Oil: Normal Firing
(Includes horizontally, opposed
and front wall firing)
- 1-01-004-04 - Grade 6 Oil: Tangential Firing
- 1-01-004-05 - Grade 5 Oil: Normal Firing
- 1-01-004-06 - Grade 5 Oil: Tangential Firing

Distillate Oil

- 1-01-005-01 - Grades 1 and 2 Oil
- 1-01-005-04 - Grade 4 Oil: Normal Firing
- 1-01-005-05 - Grade 4 Oil: Tangential Firing

Natural Gas

- 1-01-006-01 - Boilers over 100 MMBtu/Hr except
tangentially fired units
- 1-01-006-02 - Boilers under 100 MMBtu/Hr except
tangentially fired units
- 1-01-006-04 - Tangentially Fired Boilers

Process Gas (Specify Gas in Comments) C

- 1-01-007-01 - Boilers Over 100 MMBtu/Hr
- 1-01-007-02 - Boilers under 100 MMBtu/Hr

Coke C

- 1-01-008-01 - All Boiler Sizes

Wood/Bark Waste

- 1-01-009-01 - Bark-Fired Boiler
- 1-01-009-02 - Wood/Bark-Fired Boiler
- 1-01-009-03 - Wood-Fired Boiler

Liquified Petroleum Gas (LPG)

- 1-01-010-01 - Butane
- 1-01-010-02 - Propane

Bagasse

- 1-01-011-01 - All Boiler Sizes

Solid Waste

- 1-01-012-01 - Specify Waste Material in Comments

Liquid Waste

- 1-01-013-01 - Specify Waste Material in Comments
- 1-01-013-02 - Waste Oil

EXTERNAL COMBUSTION BOILERS - INDUSTRIAL

Anthracite Coal

- 1-02-001-01 - Pulverized Coal
- 1-02-001-04 - Traveling Grate Stokers
- 1-02-001-07 - Hand-Fired

Bituminous Coal

- 1-02-002-01 - Pulverized Coal: Wet Bottom
- 1-02-002-02 - Pulverized Coal: Dry Bottom
- 1-02-002-03 - Cyclone
- 1-02-002-04 - Spreader Stoker
- 1-02-002-05 - Overfeed Stoker
- 1-02-002-06 - Underfeed Stoker
- 1-02-002-12 - Pulverized Coal: Dry Bottom
(Tangential Firing)
- 1-02-002-17 - Atmospheric Fluidized Bed
- 1-02-002-19 - Cogeneration

Subbituminous Coal

- 1-02-002-21 - Pulverized Coal: Wet Bottom
- 1-02-002-22 - Pulverized Coal: Dry Bottom
- 1-02-002-23 - Cyclone
- 1-02-002-24 - Spreader Stoker
- 1-02-002-25 - Traveling Grate (Overfeed) Stoker
- 1-02-002-26 - Pulverized Coal: Dry Bottom
(Tangential Firing)
- 1-02-002-29 - Cogeneration

Lignite

- 1-02-003-01 - Pulverized Coal
- 1-02-003-02 - Pulverized Coal: Tangential Firing
- 1-02-003-03 - Cyclone
- 1-02-003-04 - Traveling Grate (Overfeed) Stoker
- 1-02-003-06 - Spreader Stoker
- 1-02-003-07 - Cogeneration

Residual Oil

- 1-02-004-01 - Grade 6 Oil
- 1-02-004-04 - Grade 5 Oil
- 1-02-004-05 - Cogeneration

Distillate Oil

- 1-02-005-01 - Grades 1 and 2 Oil
- 1-02-005-04 - Grade 4 Oil
- 1-02-005-05 - Cogeneration

Natural Gas

- 1-02-006-01 - Over 100 MMBtu/Hr
- 1-02-006-02 - 10-100 MMBtu/Hr
- 1-02-006-03 - Less Than 10 MMBtu/Hr
- 1-02-006-04 - Cogeneration

Process Gas

- 1-02-007-01 - Petroleum Refinery Gas C
- 1-02-007-04 - Blast Furnace Gas
- 1-02-007-07 - Coke Oven Gas
- 1-02-007-10 - Cogeneration
- 1-02-007-99 - Other: Specify in Comments

Coke C

- 1-02-008-02 - All Boiler Sizes
- 1-02-008-04 - Cogeneration

Wood/Bark Waste

- 1-02-009-01 - Bark-Fired Boiler (Greater than 50,000 LB Steam)
- 1-02-009-02 - Wood/Bark-Fired Boiler (Greater than 50,000 LB Steam)
- 1-02-009-03 - Wood-Fired Boiler (Greater than 50,000 LB Steam)
- 1-02-009-04 - Bark-Fired Boiler (Less than 50,000 LB Steam)
- 1-02-009-05 - Wood/Bark-Fired Boiler (Less than 50,000 LB Steam)
- T-02-009-06** - Wood-Fired Boiler (Less than 50,000 LB Steam)
- 1-02-009-07 - Wood Cogeneration

Liquified Petroleum Gas (LPG)

- 1-02-010-01 - Butane
- 1-02-010-02 - Propane

Bagasse

- T-02-011-01** - All Boiler Sizes

Solid Waste

- I-02-012-01** - Specify Waste Material in Comments

Liquid Waste (See Major Group 26, SCC 3-07-001-04 for pulp mill recovery boilers)

- I-02-013-01** - Specify Waste Material in Comments
- 1-02-013-02 - Waste Oil

CO Boiler C

- 1-02-014-01 - Natural Gas
- 1-02-014-02 - Process Gas
- 1-02-014-03 - Distillate Oil
- 1-02-014-04 - Residual Oil

EXTERNAL COMBUSTION BOILERS -**COMMERCIAL/INSTITUTIONAL****Anthracite Coal**

- I-03-001-01** - Pulverized Coal
- 1-03-001-02 - Traveling Grate Stokers
- 1-03-001-03 - Hand-Fired

Bituminous Coal

- I-03-002-05** - Pulverized Coal: Wet Bottom
- 1-03-002-06 - Pulverized Coal: Dry Bottom
- 1-03-002-07 - Overfeed Stoker
- 1-03-002-08 - Underfeed Stoker
- 1-03-002-09 - Spreader Stoker
- 1-03-002-14 - Hand-Fired
- I-03-002-16** - Pulverized Coal: Dry Bottom (Tangential Firing)
- 1-03-002-17 - Atmospheric Fluidized Bed

Subbituminous Coal

- I-03-002-21** - Pulverized Coal: Wet Bottom
- 1-03-002-22 - Pulverized Coal: Dry Bottom
- 1-03-002-23 - Cyclone
- 1-03-002-24 - Spreader Stoker
- I-03-002-25** - Traveling Grate (Overfeed) Stoker
- 1-03-002-26 - Pulverized Coal: Dry Bottom (Tangential Firing)

Lignite

- I-03-003-05** - Pulverized Coal
- 1-03-003-06 - Pulverized Coal: Tangential Firing
- 1-03-003-07 - Traveling Grate (Overfeed) Stoker
- 1-03-003-09 - Spreader Stoker

Residual Oil C

- I-03-004-01** - Grade 6 Oil
- 1-03-004-04 - Grade 5 Oil

Distillate Oil

- I-03-005-01** - Grades 1 and 2 Oil
- 1-03-005-04 - Grade 4 Oil

Natural Gas

- I-03-006-01** - Over 100 MMBtu/Hr
- 1-03-006-02 - 10-100 MMBtu/Hr
- 1-03-006-03 - Less Than 10 MMBtu/Hr

Process Gas

- I-03-007-01** - Sewage Gas
- 1-03-007-99 - Other Not Classified

Wood/Bark Waste

- I-03-009-01** - Bark-Fired Boiler
- 1-03-009-02 - Wood/Bark-Fired Boiler
- 1-03-009-03 - Wood-Fired Boiler

Liquid Petroleum Gas (LPG)

- I-03-010-01** - Butane
- 1-03-010-02 - Propane

Solid Waste

- I-03-012-01** - Specify Waste Material in Comments

Liquid Waste

- I-03-013-01** - Specify Waste Material in Comments
- 1-03-013-02 - Waste Oil
- 1-03-013-03 - Sewage Grease Skimmings

EXTERNAL COMBUSTION - SPACE HEATERS**Industrial Space Heaters C**

- I-05-001-05** - Distillate Oil
- 1-05-001-06 - Natural Gas
- 1-05-001-10 - Liquified Petroleum Gas (LPG)

Commercial Space Heaters

- I-05-002-05** - Distillate Oil C
- 1-05-002-06 - Natural Gas C
- 1-05-002-09 - Wood d
- 1-05-002-10 - Liquified Petroleum Gas (LPG) C

INTERNAL COMBUSTION ENGINES - ELECTRIC GENERATION

- 4911

Distillate Oil (Diesel)

- 2-01-001-01** - Turbine
- 2-01-001-02 - Reciprocating

Natural Gas

- 2-01-002-01** - Turbine
- 2-01-002-02 - Reciprocating

Kerosene/Naphtha (Jet Fuel) C

- 2-01-009-01** - Turbine
- 2-01-009-02 - Reciprocating

Geysers/Geothermal

- 2-01-010-01** - Steam Engine

INTERNAL COMBUSTION - INDUSTRIAL

Distillate Oil (Diesel)

- 2-02-001-01 - Turbine
- 2-02-001-02 - Reciprocating
- 2-02-001-03 - Turbine: Cogeneration
- 2-02-001-04 - Engine: Cogeneration

Natural Gas

- 2-02-002-01 - Turbine
- 2-02-002-02 - Reciprocating
- 2-02-002-03 - Turbine: Cogeneration
- 2-02-002-04 - Engine: Cogeneration

Gasoline

- 2-02-003-01 - Reciprocating

Large Bore Engine

- 2-02-004-01 - Diesel
- 2-02-004-02 - Dual Fuel (Oil/Gas)
- 2-02-004-03 - Dual Fuel (Cogeneration)^d

Residual/Crude Oil ^c

- 2-02-005-01 - Reciprocating

Kerosene/Naphtha (Jet Fuel) ^c

- 2-02-009-01 - Turbine
- 2-02-009-02 - Reciprocating

Liquified Petroleum Gas (LPG) ^d

- 2-02-010-01 - Propane: Reciprocating
- 2-02-010-02 - Butane: Reciprocating

INTERNAL COMBUSTION -

COMMERCIAL/INSTITUTIONAL

Distillate Oil (Diesel)

- 2-03-001-01 - Reciprocating
- 2-03-001-02 - Turbine

Natural Gas

- 2-03-002-01 - Reciprocating
- 2-03-002-02 - Turbine

Gasoline

- 2-03-003-01 - Reciprocating

Liquified Petroleum Gas (LPG) ^d

- 2-03-010-01 - Propane: Reciprocating
- 2-03-010-02 - Butane: Reciprocating

INTERNAL COMBUSTION - ENGINE TESTING

Aircraft

- 2-04-001-01 - Turbojet
- 2-04-001-02 - Turboshaft

Turbine ^c

- 2-04-003-01 - Natural Gas
- 2-04-003-02 - Diesel/Kerosene

Reciprocating ^c

- 2-04-004-01 - Gasoline
- 2-04-004-02 - Diesel/Kerosene

CHEMICAL MANUFACTURING - MAJOR GROUP 28

Adipic Acid - 2869

- 3-01-001-01 - General
- 3-01-001-02 - Raw Material Storage
- 3-01-001-03 - Cyclohexane Oxidation
- 3-01-001-04 - Nitric Acid Reaction
- 3-01-001-05 - Adipic Acid Refining
- 3-01-001-06 - Adipic Acid Drying/Loading and Storage
- 3-01-001-07 - Absorber
- 3-01-001-08 - Dryer
- 3-01-001-09 - Cooler
- 3-01-001-80 - Fugitive Emissions: General

Ammonia Production - 2873

- 3-01-003-05 - Feedstock Desulfurization
- 3-01-003-06 - Primary Reformer: Natural Gas Fired
- 3-01-003-07 - Primary Reformer: Oil Fired
- 3-01-003-08 - Carbon Dioxide Regenerator
- 3-01-003-09 - Condensate Stripper

Carbon Black Production - 2895

- 3-01-005-01 - Channel Process^g
- 3-01-005-02 - Thermal Process
- 3-01-005-03 - Gas Furnace Process^h (Main Process Vent)
- 3-01-005-04 - Oil Furnace Process (Main Process Vent)
- 3-01-005-06 - Transport Air Vent
- 3-01-005-07 - Pellet Dryer
- 3-01-005-08 - Bagging/Loading
- 3-01-005-09 - Furnace Process Fugitive Emissions

Charcoal Manufacture - 2861

- 3-01-006-01 - General
- 3-01-006-03 - Batch Kiln
- 3-01-006-04 - Continuous Furnace
- 3-01-006-05 - Briquetting
- 3-01-006-99 - Other Not Classified (Specify in Comments)

Chloro-Alkali Production - 2812

- 3-01-008-01 - Liquefaction (Diaphragm Cell Process)
- 3-01-008-02 - Liquefaction (Mercury Cell Process)
- 3-01-008-03 - Chlorine Loading: Tank Car Vents
- 3-01-008-04 - Chlorine Loading: Storage Tank Vents
- 3-01-008-05 - Air Blowing of Mercury Cell Brine

Cleaning Chemicals - 2841, 2842

- 3-01-009-01 - Spray Drying: Soaps & Detergents
- 3-01-009-02 - Speciality Cleaners
- 3-01-009-99 - Other Not Classified (Specify in Comments)

INTERNAL COMBUSTION - FUGITIVE EMISSIONS

Other Not Classified

- 2-88-888-01 - Specify in Comments
- 2-88-888-02 - Specify in Comments
- 2-88-888-03 - Specify in Comments

Explosives - Trinitrotoluene - 2892

- 3-01-010-11 - Batch Process: Nitration Reactors Fume Recovery
- 3-01-010-12 - Batch Process: Nitration Reactors Acid Recovery
- 3-01-010-13 - Batch Process: Nitric Acid Concentrators
- 3-01-010-14 - Batch Process: Sulfuric Acid Concentrators-Electrostatic Precipitators (Exit)
- 3-01-010-15 - Batch Process: Red Water Incinerator
- 3-01-010-21 - Continuous Process: Nitration Reactors-(Fume Recovery)
- 3-01-010-22 - Continuous Process: Nitration Reactors-(Acid Recovery)
- 3-01-010-23 - Continuous Process: Red Water Incinerator
- 3-01-010-30 - Open Burning: Waste

Hydrochloric Acid - 2819

- 3-01-011-01 - By-Product Process
- 3-01-011-98 - Handling & Storage (99.9% Removal)

Hydrofluoric Acid - 2819

- 3-01-012-02 - Rotary Kitn (Acid Reactor)
- 3-01-012-03 - Fluorspar Grinding/Drying
- 3-01-012-04 - Fluorspar Handling Silos
- 3-01-012-05 - Fluorspar Transfer
- 3-01-012-06 - Tail Gas Vent

Nitric Acid - 2873

- 3-01-013-01 - Absorber Tail Gas (Pre-1970 Facilities)
- 3-01-013-02 - Absorber Tail Gas (Post-1970 Facilities)
- 3-01-013-03 - Nitric Acid Concentration (Pre-1970 Facilities)
- 3-01-013-04 - Nitric Acid Concentration (Post-1970 Facilities)

Paint Manufacture - 2851 i

- 3-01-014-01 - General Mixing & Handling
- 3-01-014-02 - Pigment Handling
- 3-01-014-99 - Other Not Classified (Specify in Comments)

Varnish Manufacture - 2851

- 3-01-015-01 - Bodying Oil
- 3-01-015-02 - Oleoresinous
- 3-01-015-03 - Alkyd
- 3-01-015-05 - Acrylic
- 3-01-015-99 - Other Not Classified (Specify in Comments)

Phosphoric Acid: Wet Process - 2874

- 3-01-016-01 - Reactor
- 3-01-016-02 - Gypsum Pond
- 3-01-016-03 - Condensor

Phosphoric Acid: Thermal Process - 2874

- 3-01-017-02 - Absorber: General
- 3-01-017-03 - Absorber w/Packed Tower
- 3-01-017-04 - Absorber w/Venturi Scrubber
- 3-01-017-05 - Absorber w/Glass Mist Eliminator
- 3-01-017-06 - Absorber w/Wire Mist Eliminator
- 3-01-017-07 - Absorber w/High-pressure Mist Eliminator
- 3-01-017-08 - Absorber w/Electrostatic Precipitator

Plastics Production - Specific Products - 2821

- 3-01-018-01 - Polyvinyl Chlorides & Copolymers
- 3-01-018-02 - Polypropylene and Copolymers
- 3-01-018-03 - Ethylene-Propylene Copolymers
- 3-01-018-05 - Phenolic Resins

Polyethylene (High Density)

- 3-01-018-08 - Monomer & Solvent Recovery
- 3-01-018-09 - Extruder
- 3-01-018-10 - Conveying
- 3-01-018-11 - Storage

Polyethylene (Low Density)

- 3-01-018-12 - Recovery & Purification System
- 3-01-018-14 - Extruder
- 3-01-018-15 - Pellet Silo
- 3-01-018-16 - Transfer/Handling/Loading/Packing

Polystyrene

- 3-01-018-18 - Reactor
- 3-01-018-19 - Solvent Recovery
- 3-01-018-20 - Polymer Drying
- 3-01-018-21 - Extruding/Pelletizing/Conveying/Storage

Acrylic Resins

- 3-01-018-27 - Polyamide Resins
- 3-01-018-32 - Urea-Formaldehyde Resins
- 3-01-018-37 - Polyester Resins: General
- 3-01-018-38 - Polyester/Alkyd Resins: Reactor Kettle
- 3-01-018-39 - Polyester/Alkyd Resins: Resin Thinning Tank
- 3-01-018-40 - Polyester/Alkyd Resins: Resin Storage Tank
- 3-01-018-42 - Melamine Resins
- 3-01-018-47 - Epoxy Resins
- 3-01-018-52 - Polyfluorocarbons

Polyethylene - 2821 j

- 3-01-018-60 - Recovery System
- 3-01-018-61 - Purification System
- 3-01-018-63 - Extruder
- 3-01-018-64 - Pellet Silo/Storage
- 3-01-018-65 - Transfer/Conveying
- 3-01-018-66 - Packing/Shipping

Plastics Production - General Processes - 2821

- 3-01-018-90 - Catalyst Preparation
- 3-01-018-91 - Reactor Vents
- 3-01-018-92 - Separation Processes
- 3-01-018-93 - Raw Material Storage
- 3-01-018-94 - Solvent Storage
- 3-01-018-99 - Other Not Classified (Specify in Comments)

Pthalic Anhydride - 2865

- 3-01-019-01 - o-Xylene Oxidation: Main Process Stream (Reactor Condensers)
- 3-01-019-02 - o-Xylene Oxidation: Pre-treatment
- 3-01-019-04 - o-Xylene Oxidation: Distillation
- 3-01-019-05 - Naphthalene Oxidation: Main Process Stream (Reactor/Condensers)
- 3-01-019-06 - Naphthalene Oxidation: Pre-treatment
- 3-01-019-07 - Naphthalene Oxidation: Distillation

Printing Ink Manufacture - 2893

- 3-01-020-01 - Vehicle Cooking: General
- 3-01-020-02 - Vehicle Cooking: Oils
- 3-01-020-03 - Vehicle Cooking: Oleoresin
- 3-01-020-04 - Vehicle Cooking: Alkyds
- 3-01-020-05 - Pigment Mixing

Sodium Carbonate - 2812

- 3-01-021-01 - Solvay Process: NH₃ Recovery
- 3-01-021-02 - Solvay: Handling
- 3-01-021-03 - Trona Crushing/Screening
- 3-01-021-04 - Calciner: Gas-Fired
- 3-01-021-05 - Calciner: Coal-Fired
- 3-01-021-06 - Rotary Dryer
- 3-01-021-07 - Fluid Bed Dryer
- 3-01-021-08 - Dissolver
- 3-01-021-12 - Rotary Predryer
- 3-01-021-13 - Bleacher: Gas-Fired
- 3-01-021-99 - Other Not Classified
(Specify in Comments)

Sulfuric Acid, Chamber Process - 2819

- 3-01-022-01 - General
- 3-01-023-01 - Absorber/@ 99.9% Conversion
- 3-01-023-04 - Absorber/@ 99.5% Conversion
- 3-01-023-06 - Absorber/@ 99.0% Conversion
- 3-01-023-08 - Absorber/@ 98.0% Conversion
- 3-01-023-10 - Absorber/@ 97.0% Conversion
- 3-01-023-12 - Absorber/@ 96.0% Conversion
- 3-01-023-14 - Absorber/@ 95.0% Conversion
- 3-01-023-16 - Absorber/@ 94.0% Conversion
- 3-01-023-18 - Absorber/@ 93.0% Conversion
- 3-01-023-19 - Concentrator
- 3-01-023-20 - Tank Car and Truck Unloading
- 3-01-023-21 - Storage Tank Vents
- 3-01-023-22 - Leaks in Process Equipment

Synthetic Organic Fiber Production -

Specific Products - 2824

- 3-01-024-01 - Polyamide (e.g., Nylon)
- 3-01-024-02 - Polyesters (e.g., Dacron)
- 3-01-024-05 - Polyfluorocarbons (e.g., Teflon)
- 3-01-024-10 - Acrylics (e.g., Orlon)
- 3-01-024-14 - Polyolefins (e.g., Polypropylene)
- 3-01-024-15 - Vinyls (e.g., Saran)
- 3-01-024-16 - Aramid

Synthetic Organic Fiber Production -

General Processes - 2824

- 3-01-024-21 - Dope Preparation
- 3-01-024-22 - Filtration
- 3-01-024-23 - Fiber Extrusion
- 3-01-024-24 - Washing/Drying/Finishing
- 3-01-024-25 - Fiber Storage
- 3-01-024-26 - Equipment Cleanup
- 3-01-024-27 - Solvent Storage

Cellulosic Fiber Production - 2823

- 3-01-025-01 - Viscose (e.g., Rayon)
- 3-01-025-05 - Acetate

Synthetic Rubber Production (Manufacturing Only)

- 2822

- 3-01-026-01 - General
- 3-01-026-02 - Butyl (Isobutylene)
- 3-01-026-08 - Acrylonitrile
- 3-01-026-09 - Dryers
- 3-01-026-10 - Blowdown Tank
- 3-01-026-11 - Steam Stripper
- 3-01-026-12 - Prestorage Tank
- 3-01-026-13 - Monomer Recovery (Absorber Vent)
- 3-01-026-14 - Blending Tanks
- 3-01-026-15 - Isoprene
- 3-01-026-16 - Latex: Monomer Removal
- 3-01-026-17 - Latex: Blending Tank
- 3-01-026-25 - Chloroprene
- 3-01-026-30 - Silicone Rubber
- 3-01-026-99 - Other Not Classified
(Specify in Comments)

Ammonium Nitrate Production - 2873

- 3-01-027-04 - Neutralizer
- 3-01-027-07 - Rotary Drum Granulator
- 3-01-027-08 - Pan Granulator
- 3-01-027-09 - Bulk Loading (General)
- 3-01-027-10 - Bagging Product
- 3-01-027-11 - Neutralizer (High Density)
- 3-01-027-12 - Prilling Tower (High Density)
- 3-01-027-14 - Prill Coolers (High Density)
- 3-01-027-17 - Evaporator/Concentrator
(High Density)
- 3-01-027-18 - Coating (High Density)
- 3-01-027-20 - Solids Screening
- 3-01-027-21 - Neutralizer (Low Density)
- 3-01-027-22 - Prilling Towers (Low Density)
- 3-01-027-24 - Prill Coolers (Low Density)
- 3-01-027-25 - Prill Dryer (Low Density)
- 3-01-027-27 - Evaporator/Concentrator
(Low Density)
- 3-01-027-28 - Coating (Low Density)
- 3-01-027-29 - Rotary Drum Granulator Coolers
- 3-01-027-30 - Pan Granulator Cooler

Normal Superphosphate - 2874

- 3-01-028-01 - Grinding & Drying
- 3-01-028-03 - Rock Unloading
- 3-01-028-04 - Rock Feeder System
- 3-01-028-05 - Mixer/Den
- 3-01-028-06 - Curing Building
- 3-01-028-07 - Bagging/Handling
- 3-01-028-20 - Mixing

3-01-028-21 - Den

3-01-028-22 - Curing

3-01-028-23 - Ammoniator/Granulator

3-01-028-24 - Dryer

3-01-028-25 - Cooler

Triple Superphosphate (Also Called Double or Concentrated Superphosphate) - 2874

- 3-01-029-03 - Rock Unloading
- 3-01-029-04 - Rock Feeder System
- 3-01-029-05 - Run-of-Pile: Mixer/Den/
Curing
- 3-01-029-06 - Granular: Reactor/Dryer
- 3-01-029-07 - Granular: Curing
- 3-01-029-08 - Bagging/Handling
- 3-01-029-20 - Mixing
- 3-01-029-21 - Den
- 3-01-029-22 - Curing
- 3-01-029-23 - Ammoniator/Granulator
- 3-01-029-24 - Dryer
- 3-01-029-25 - Cooler

Ammonium Phosphates - 2874

- 3-01-030-01 - Dryers & Coolers
- 3-01-030-02 - Ammoniator/Granulator
- 3-01-030-03 - Screening/Transfer
- 3-01-030-04 - Bagging/Handling
- 3-01-030-20 - Mixing
- 3-01-030-21 - Den
- 3-01-030-22 - Curing
- 3-01-030-23 - Ammoniator/Granulator
- 3-01-030-24 - Dryer
- 3-01-030-25 - Cooler

Terephthalic Acid/Dimethyl Terephthalate - 2869

- 3-01-031-01 - HNO₃ - Paraxylene - General
- 3-01-031-02 - Reactor Vent
- 3-01-031-03 - Crystallization, Separation &
Drying Vent
- 3-01-031-04 - Distillation & Recovery Vent
- 3-01-031-05 - Product Transfer Vent
- 3-01-031-99 - Other Not Classified
(Specify in Comments)

Elemental Sulfur Production - 2819

- 3-01-032-01 - Modified Clause: 2 Stage w/o
Control (92-95% Removal)
- 3-01-032-02 - Modified Clause: 3 Stage w/o
Control (95-96% Removal)
- 3-01-032-03 - Modified Clause: 4 Stage w/o
Control (96-97% Removal)
- 3-01-032-04 - Sulfur Removal Process
(99.9% Removal)

Pesticides - 2879

- 3-01-033-01 - Malathion
- 3-01-033-99 - Other Not Classified
(Specify in Comments)

Amines/Amides Production - 2869

Aniline - 2869

- 3-01-034-02 - General
- 3-01-034-03 - Reactor Recycle Purge Vent
- 3-01-034-04 - Dehydration Column Vent
- 3-01-034-05 - Purification Column Vent
- 3-01-034-06 - Fugitive Emissions: General

Ethanolamines - 2869

- 3-01-034-10 - General
- 3-01-034-11 - Ammonia Scrubber Vent
- 3-01-034-12 - Vacuum Distillation-Jet Vent
- 3-01-034-14 - Fugitive Emissions: General

- 3-01-034-15 - Ethylenediamine
- 3-01-034-20 - Hexamethylenediamine
- 3-01-034-25 - Hexamethylenetetramine
- 3-01-034-30 - Melamine
- 3-01-034-35 - Methylamines
- 3-01-034-99 - Other Not Classified
(Specify in Comments)

Inorganic Pigments - 2816

- 3-01-035-01 - TiO₂ Sulfate Process: Calciner^d
- 3-01-035-02 - TiO₂ Sulfate Process: Digestor
- 3-01-035-03 - TiO₂ Chloride Process: Reactor^d
- 3-01-035-06 - Lead Oxide: Barton Pot
- 3-01-035-07 - Lead Oxide: Calcining Furnace
- 3-01-035-10 - Red Lead
- 3-01-035-15 - White Lead
- 3-01-035-20 - Lead Chromate
- 3-01-035-50 - Ore Grinding
- 3-01-035-51 - Ore Dryer
- 3-01-035-52 - Pigment Milling
- 3-01-035-53 - Pigment Dryer
- 3-01-035-54 - Conveying/Storage/Packing
- 3-01-035-99 - Other Not Classified
(Specify in Comments)

Sodium Bicarbonate - 2812

- 3-01-038-01 - General

Hydrogen Cyanide - 2819

- 3-01-039-01 - General
- 3-01-039-02 - Ammonia Absorber
- 3-01-039-03 - HCN Absorber

Urea Production - 2873

- 3-01-040-01 - General: Specify in Comments
- 3-01-040-02 - Solution Concentration (Controlled)
- 3-01-040-03 - Prilling
- 3-01-040-04 - Drum Granulation
- 3-01-040-05 - Solid Product: Coating
- 3-01-040-06 - Solid Product: Bagging
- 3-01-040-07 - Bulk Loading
- 3-01-040-08 - Non-Fluidized Bed Prilling
(Agricultural Grade)
- 3-01-040-09 - Non-Fluidized Bed Prilling
(Feed Grade)
- 3-01-040-10 - Fluidized Bed Prilling
(Agricultural Grade)
- 3-01-040-11 - Fluidized Bed Prilling
(Feed Grade)
- 3-01-040-12 - Rotary Drum Cooler
- 3-01-040-13 - Solids Screening

Nitrocellulose - 2892

- 3-01-041-01 - Nitration Reactors
- 3-01-041-02 - Sulfuric Acid Concentrator
- 3-01-041-03 - Boiling Tubs
- 3-01-041-04 - Nitric Acid Concentrator

Lead Alkyl Manufacture - (Sodium/Lead Alloy Process)
- 2869

- 3-01-042-01 - Recovery Furnace
- 3-01-042-02 - Process Vents (Tetraethyl Lead)
- 3-01-042-03 - Process Vents (Tetramethyl Lead)
- 3-01-042-04 - Sludge Pits

Lead Alkyl Manufacture - (Electrolytic Process) - 2869

- 3-01-043-01 - General

Organic Fertilizer - 2873

- 3-01-045-01 - General: Mixing/Handling

Pharmaceutical Preparations - 2834

- 3-01-060-01 - Vacuum Dryers
- 3-01-060-02 - Reactors
- 3-01-060-03 - Distillation Units
- 3-01-060-04 - Filters
- 3-01-060-05 - Extractors
- 3-01-060-06 - Centrifuges
- 3-01-060-07 - Crystallizers
- 3-01-060-08 - Exhaust Systems
- 3-01-060-09 - Air Dryers
- 3-01-060-10 - Storage/Transfer
- 3-01-060-99 - Other Not Classified
(Specify in Comments)

Industrial Inorganic Chemical Production -

General Processes - 2812-2819

- 3-01-070-01 - Fugitive Leaks
- 3-01-070-02 - Storage/Transfer

Ketone Production - 2869

- 3-01-091-05 - Methyl Ethyl Ketone (MEK)
- 3-01-091-10 - Methyl Isobutyl Ketone (MIBK)

Acetone - 2869

- 3-01-091-01 - Acetone: General
- 3-01-091-51 - Cumene Oxidation
- 3-01-091-52 - CHP Concentrator
- 3-01-091-53 - Light-ends Distillation Vent
- 3-01-091-54 - Acetone Finishing Column
- 3-01-091-80 - Fugitive Emissions: General

Ketone Production - 2869

- 3-01-091-99 - Other Not Classified
(Specify in Comments)

Maleic Anhydride - 2865

- 3-01-100-02 - Product Recovery Absorber
- 3-01-100-03 - Vacuum System Vent
- 3-01-100-04 - Briquetting
- 3-01-100-05 - Secondary Sources (Dehydration Column, Vacuum System, Fractionation Column)
- 3-01-100-99 - Other Not Classified
(Specify in Comments)

Aldehydes Production - 2869

Formaldehyde - 2869

- 3-01-120-01 - Formaldehyde: Silver Catalyst
- 3-01-120-02 - Formaldehyde: Mixed Oxide Catalyst
- 3-01-120-05 - Absorber Vent
- 3-01-120-06 - Fractionator Vent
- 3-01-120-07 - Fugitive Emissions: General

Acetaldehyde - 2869

- 3-01-120-11 - Acetaldehyde from Ethylene
- 3-01-120-12 - Acetaldehyde from Ethanol
- 3-01-120-13 - Off-Air Absorber Vent
- 3-01-120-14 - Off-Gas Absorber Vent
- 3-01-120-17 - Fugitive Emissions: General

Butyraldehyde - 2869

- 3-01-120-21 - General

Acrolein - 2869

- 3-01-120-31 - CO₂ Stripping Tower
- 3-01-120-32 - Aqueous Acrolein Receiver
- 3-01-120-33 - Distillation System
- 3-01-120-34 - Refrigeration Unit
- 3-01-120-37 - Fugitive Emissions: General
- 3-01-120-99 - Other Not Classified
(Specify in Comments)

Organic Dyes/Pigments - 2865

- 3-01-121-99 - Other Not Classified
(Specify in Comments)

Chloroprene - 2869

- 3-01-124-01 - General
- 3-01-124-02 - Butadiene Dryer
- 3-01-124-03 - Chlorination Reactor
- 3-01-124-04 - Dichlorobutene Still
- 3-01-124-05 - Isomerization & 3,4 DCB Recovery Vent
- 3-01-124-06 - Chloroprene Stripper
- 3-01-124-07 - Brine Stripper
- 3-01-124-80 - Fugitive Emissions: General

Organohalogens Production - 2869

Ethylene Dichloride - 2869

- 3-01-125-01 - Ethylene Dichloride via Oxychlorination
- 3-01-125-02 - Ethylene Dichloride via Direct Chlorination
- 3-01-125-04 - Caustic Scrubber
- 3-01-125-05 - Reactor Vessel
- 3-01-125-06 - Distillation Unit
- 3-01-125-09 - Fugitive Emissions: General

Chloromethanes - 2869

- 3-01-125-10 - General
- 3-01-125-11 - Recycled Methane Inert-Purge Gas Vent
- 3-01-125-12 - Drying Bed Regeneration Vent
- 3-01-125-14 - Fugitive Emissions: General

Ethyl Chloride - 2869

- 3-01-125-15 - Ethyl Chloride: General

Perchloroethylene - 2869

- 3-01-125-20 - General
- 3-01-125-21 - Distillation Vent
- 3-01-125-22 - Caustic Scrubber
- 3-01-125-24 - Fugitive Emissions: General

1,1,1-Trichloroethane (Methyl Chloroform) - 2869

- 3-01-125-25 - General
- 3-01-125-26 - HCL Absorber Vent
- 3-01-125-27 - Drying Column Vent
- 3-01-125-28 - Distillation Column Vent
- 3-01-125-29 - Fugitive Emissions: General

Trichloroethylene - 2869

- 3-01-125-30 - General
- 3-01-125-31 - Distillation Unit
- 3-01-125-32 - Neutralizer
- 3-01-125-33 - Product Recovery Column
- 3-01-125-34 - Fugitive Emissions: General

Chlorobenzene - 2869

- 3-01-125-35 - General

<u>Vinyl Chloride - 2869</u>	<u>Bisphenol A - 2869</u>
3-01-125-40 - General	3-01-152-01 - General
3-01-125-41 - Cracking Furnace	
3-01-125-42 - HCL Recovery	<u>Butadiene - 2869</u>
3-01-125-43 - Light-ends Recovery Vent	3-01-153-01 - General
3-01-125-44 - Drying Column/Dichloroethane	3-01-153-10 - Houdry Process: General
3-01-125-45 - Drying Column/Vinyl Chloride Monomer	3-01-153-11 - Flue Gas Vent
3-01-125-46 - Product Recovery Still	3-01-153-12 - Dehydrogenation Reactor
3-01-125-47 - Cracking Furnace Decoking	3-01-153-20 - N-Butene Process: General
3-01-125-50 - Fugitive Emissions: General	3-01-153-21 - Flue Gas Vent
<u>Vinylidene Chloride - 2869</u>	3-01-153-22 - Hydrocarbon Absorber Column
3-01-125-51 - General	3-01-153-80 - Fugitive Emissions: General
3-01-125-52 - Dehydrochlorination Reactor Purge Vent	<u>Cumene Production - 2865</u>
3-01-125-53 - Distillation Column Vents	3-01-156-01 - General
3-01-125-55 - Fugitive Emissions: General	3-01-156-02 - Benzene Drying Column
<u>Chlorinated Organics - Other Not Classified - 2869</u>	3-01-156-03 - Catalyst Mix Tank Scrubber Vent
3-01-125-99 - Chlorine Organics: Specify in Comments	3-01-156-04 - Wash-Decant System Vent
<u>Brominated Organics - 2869</u>	3-01-156-05 - Benzene Recovery
3-01-126-99 - Bromine Organics	3-01-156-06 - Cumene Distillation System Vent
<u>Fluorocarbons/Chlorofluorocarbons - 2869</u>	3-01-156-07 - DIPB Stripping Vent
3-01-127-01 - General	3-01-156-08 - Fugitive Emissions: General
3-01-127-02 - Distillation Column	
3-01-127-03 - HCL Recovery Column	<u>Cyclohexane - 2865</u>
3-01-127-80 - Fugitive Emissions: General	3-01-157-01 - General
<u>Ammonium Sulfate - 2873</u>	3-01-157-02 - Blowdown Tank Discharge
3-01-130-04 - Rotary Dryer	3-01-157-03 - Pumps/Valves/Compressors
3-01-130-05 - Fluid Bed Dryer	3-01-157-04 - Catalyst Replacement
<u>Organic Acids Production - 2869</u>	3-01-157-80 - Fugitive Emissions: General
<u>Acetic Acid - 2869</u>	<u>Cyclohexanone/ol - 2869</u>
3-01-132-01 - Acetic Acid via Methanol	3-01-158-01 - General
3-01-132-05 - Acetic Acid via Butane	3-01-158-80 - Fugitive Emissions: General
3-01-132-10 - Acetic Acid via Acetaldehyde	
<u>Acrylic Acid - 2869</u>	<u>Cyclohexanone/ol - Cyclohexane Oxidation Process - 2869</u>
3-01-132-21 - General	3-01-158-02 - High Pressure Scrubber Vent
3-01-132-22 - Quench Absorber	3-01-158-03 - Low Pressure Scrubber Vent
3-01-132-23 - Extraction Column	
3-01-132-24 - Vacuum System	<u>Cyclohexanone/ol - Phenol Hydrogenation Process - 2869</u>
3-01-132-27 - Fugitive Emissions: General	3-01-158-21 - Hydrogenation Reactor Vent
<u>Organic Acids Production - 2869</u>	3-01-158-22 - Distillation Vent
3-01-132-99 - Other Not Classified	
(Specify in Comments)	<u>Vinyl Acetate - 2869</u>
<u>Acetic Anhydride - 2869</u>	3-01-167-01 - General
3-01-133-01 - General	3-01-167-02 - Inert-Gas Purge Vent
3-01-133-02 - Reactor By-Product Gas Vent	3-01-167-03 - CO ₂ Vent
3-01-133-03 - Distillation Column Vent	3-01-167-04 - Inhibitor Mix Tank Discharge
3-01-133-80 - Fugitive Emissions: General	3-01-167-80 - Fugitive Emissions: General
<u>Esters Production - 2869</u>	3-01-167-99 - Specify in Comments
3-01-137-99 - Acrylates: Specify in	<u>Ethylbenzene - 2865</u>
Comments	3-01-169-01 - General
<u>Acetylene Production - 2813</u>	3-01-169-02 - Alkylation Reactor Vent
3-01-140-01 - Raw Material Handling	3-01-169-03 - Benzene Drying
3-01-140-02 - Grinding/Milling	3-01-169-04 - Benzene Recovery/Recycle
3-01-140-03 - Mixing	3-01-169-05 - Ethylbenzene Recovery
3-01-140-04 - Waste Handling	3-01-169-06 - Polyethylbenzene Recovery
3-01-140-05 - General	3-01-169-80 - Fugitive Emissions: General

Ethylene Oxide - 2869

3-01-174-01 - General
3-01-174-02 - Air-Oxidation Process Reactor-Main Vent
3-01-174-10 - Oxygen-Oxidation Process Reactor-CO₂ Purge Vent
3-01-174-11 - Oxygen-Oxidation Process Reactor-Argon Purge Vent
3-01-174-21 - Stripper Purge Vent
3-01-174-80 - Fugitive Emissions: General

Glycerin (Glycerol) - 2869

3-01-176-01 - General

3-01-176-10 - Chlorination Process: General
3-01-176-11 - CO₂ Absorber Vent
3-01-176-12 - Evaporator
3-01-176-13 - Concentrator
3-01-176-14 - Stripping Column
3-01-176-15 - Light-ends Stripping Column
3-01-176-16 - Solvent Stripping Column
3-01-176-17 - Product Distillation Column
3-01-176-18 - Cooling Tower

3-01-176-30 - Oxidation Process: General
3-01-176-31 - Light-ends Stripper
3-01-176-32 - Concentrator
3-01-176-33 - Glycerin Flasher Column
3-01-176-34 - Product Distillation Column

3-01-176-80 - Fugitive Emissions: General

Toluene Diisocyanate - 2865

3-01-181-01 - General
3-01-181-02 - Sulfuric Acid Concentrator
3-01-181-03 - Nitration Reactor
3-01-181-04 - Catalyst Filtration
3-01-181-05 - TDA Vacuum Distillation Unit
3-01-181-06 - Dichlorobenzene Solvent Recovery
3-01-181-07 - TDI Flash Distillation
3-01-181-08 - TDI Purification
3-01-181-09 - Residue Vacuum Distillation Unit
3-01-181-10 - HCL Absorber
3-01-181-80 - Fugitive Emissions: General

Methyl Methacrylate - 2869

3-01-190-01 - General
3-01-190-02 - Acetone Cyanohydrin Reactor Off-Gas
3-01-190-03 - Recovery Columns
3-01-190-04 - Acetone Evaporation Vacuum Vent
3-01-190-10 - Hydrolysis Reactor
3-01-190-11 - Distillation Unit
3-01-190-12 - MMA & Light-ends Distillation Unit
3-01-190-13 - Acid Distillation
3-01-190-14 - MMA Purification
3-01-190-80 - Fugitive Emissions: General

Nitrobenzene - 2865

3-01-195-01 - General
3-01-195-02 - Reactor & Separator Vent
3-01-195-03 - Acid Stripper Vent
3-01-195-04 - Washer & Neutralizer Vent
3-01-195-05 - Nitrobenzene Stripper Vent
3-01-195-06 - Waste Acid Storage
3-01-195-80 - Fugitive Emissions: General

Olefins Production - 2869

Ethylene - 2869
3-01-197-01 - General
3-01-197-41 - Flue Gas Vent
3-01-197-42 - Pyrolysis Furnace Decoking
3-01-197-43 - Acid Gas Removal
3-01-197-44 - Catalyst Regeneration
3-01-197-45 - Compressor Lube Oil Vent
3-01-197-49 - Fugitive Emissions: General

Propylene - 2869

3-01-197-05 - General
3-01-197-06 - Reactor
3-01-197-07 - Drying Tower
3-01-197-08 - Light-ends Stripper
3-01-197-09 - Fugitive Emissions: General

Butylene - 2869

3-01-197-10 - General

3-01-197-99 - Other Not Classified
(Specify in Comments)

Phenol - 2865

3-01-202-01 - General
3-01-202-02 - Cumene Oxidation
3-01-202-03 - CHP Concentrator
3-01-202-04 - Light-ends Distillation Vent
3-01-202-05 - Acetone Finishing Column
3-01-202-06 - Phenol Distillation Column
3-01-202-10 - Oxidate Wash/Separation
3-01-202-11 - CHP Cleavage Vent
3-01-202-80 - Fugitive Emissions: General

Propylene Oxide - 2869

3-01-205-01 - General
3-01-205-02 - Chlorohydration Process: General
3-01-205-03 - Vent Gas Scrubber Vent
3-01-205-04 - Saponification Column Vent
3-01-205-05 - PO Stripping Column Vent
3-01-205-06 - Light-ends Stripping Column Vent
3-01-205-07 - PO Final Distillation Column Vent
3-01-205-08 - DCP Distillation Column Vent
3-01-205-09 - DCIPE Distillation Column Vent
3-01-205-20 - Isobutane Hydroperoxide Process: General
3-01-205-21 - Oxidation Reactor Scrubber Vent
3-01-205-22 - TBA Stripping Column Vent
3-01-205-23 - Catalyst Mix Tank Vent
3-01-205-24 - PO Stripping Column Vent
3-01-205-25 - Crude TBA Recovery Column Vent
3-01-205-26 - TBA Wash-Decant System Vent
3-01-205-27 - Wastewater Stripping Column Vent
3-01-205-28 - Solvent Scrubber Vent
3-01-205-29 - Solvent Recovery Column Vent
3-01-205-30 - Water Stripping Column Vent
3-01-205-31 - Propylene Glycol & Dipropylene Glycol Combined Column Vent
3-01-205-32 - Flue Gas Vent

3-01-205-40 - Ethylbenzene Hydroperoxide Process: General
3-01-205-41 - Oxidation Reactor Scrubber Vent
3-01-205-42 - Falling Film Evaporator Vent
3-01-205-43 - Catalyst Mix Tank Vent
3-01-205-44 - Separation Column Vent
3-01-205-45 - Light-ends Stripping Column Vent
3-01-205-46 - Propylene Recovery Column Vent
3-01-205-47 - Product Wash-Decant System Vent

3-01-205-48 - Mixed Hydrocarbon Wash-Decant System Vent
3-01-205-49 - Ethylbenzene Wash-Decant System Vent
3-01-205-50 - Ethylbenzene Stripping Column Vent
3-01-205-51 - Light Hydrocarbon Stripping Column Vent
3-01-205-52 - MBA-AP Stripping Column Vent
3-01-205-53 - Dehydration Reactor System Vent
3-01-205-54 - Light Impurities Stripping Column Vent
3-01-205-55 - Styrene Finishing Column Vent
3-01-205-80 - Fugitive Emissions: General

Styrene - 2865

3-01-206-01 - General
3-01-206-02 - Benzene Recycle
3-01-206-03 - Styrene Purification
3-01-206-80 - Fugitive Emissions: General

Caprolactum - 2869

3-01-210-01 - General
3-01-210-02 - Cyclohexanone Purification Vent
3-01-210-03 - Dehydrogenation Reactor Vent
3-01-210-04 - Oleum Reactor
3-01-210-05 - Neutralization Reactor Vent
3-01-210-06 - Solvent Separation/Recovery
3-01-210-07 - Oximation Reactor & Separator
3-01-210-08 - Caprolactum Purification
3-01-210-09 - Ammonium Sulfate Drying
3-01-210-10 - Ammonium Sulfate Cooling/Screening/Storage/
Loading
3-01-210-80 - Fugitive Emissions: General

Linear Alkylbenzene - 2869

3-01-211-01 - Olefin Process: General
3-01-211-02 - Benzene Drying
3-01-211-03 - Hydrogen Fluoride Scrubber Vent
3-01-211-04 - Vacuum Refining
3-01-211-21 - Chlorination Process: General
3-01-211-22 - Paraffin Drying Column Vent
3-01-211-23 - HCL Absorber Vent
3-01-211-24 - Atmospheric Wash-Decant Vent
3-01-211-25 - Benzene Stripping Column Vent
3-01-211-80 - Fugitive Emissions: General

Alcohols Production - 2869

Methanol - 2869
3-01-250-01 - General
3-01-250-02 - Purge Gas Vent
3-01-250-03 - Distillation Vent
3-01-250-04 - Fugitive Emissions: General

Alcohols Production - 2869

3-01-250-05 - Ethanol from Ethylene
3-01-250-10 - Ethanol by Fermentation
3-01-250-15 - Isopropanol
3-01-250-20 - Alcohols by Oxo Process
3-01-250-25 - Fatty Alcohols by
Hydrogenation
3-01-250-99 - Other Not Classified
(Specify in Comments)

Ethylene Glycol - 2869

3-01-251-01 - General
3-01-251-02 - Evaporator Purge Vent
3-01-251-03 - Water Removal Steam-Jet Ejector
3-01-251-04 - Distillation Column Vent
3-01-251-80 - Fugitive Emissions: General

Ethers Production - 2869

3-01-252-01 - General

Glycol Ethers - 2869

3-01-253-01 - General
3-01-253-02 - Vacuum System Vent
3-01-253-05 - Catalyst-Methanol Mix Tank
3-01-253-06 - Methanol Recovery Column Vent
3-01-253-15 - Catalyst-Ethanol Mix Tank
3-01-253-16 - Ethanol Recovery Column Vent
3-01-253-25 - Catalyst-Butanol Mix Tank
3-01-253-26 - Butanol Recovery Column Vent
3-01-253-80 - Fugitive Emissions: General

Nitriles Production - 2869

3-01-254-01 - Acetonitrile

Acrylonitrile - 2869

3-01-254-05 - General
3-01-254-06 - Absorber Vent: Normal
3-01-254-07 - Absorber Vent: Startup
3-01-254-08 - Recovery/Purification Column Vent
3-01-254-09 - Fugitive Emissions: General

Adiponitrile - 2869

3-01-254-10 - via Adipic Acid: General
3-01-254-11 - Ammonia Recovery Still
3-01-254-12 - Product Fractionator
3-01-254-13 - Product Recovery Vent
3-01-254-15 - via Butadiene: General
3-01-254-16 - Chlorination Reactor
3-01-254-17 - Cyanide Synthesis
3-01-254-18 - Cyanation/Isomerization
3-01-254-20 - Fugitive Emissions: General

Nitriles Production - 2869

3-01-254-99 - Other Not Classified
(Specify in Comments)

Aromatics Production - 2869

Benzene Production - 2869
3-01-258-01 - General
3-01-258-02 - Reactor
3-01-258-03 - Distillation Unit

Toluene Production - 2869

3-01-258-05 - General
3-01-258-06 - Reactor
3-01-258-07 - Distillation Unit

Aromatics Production - 2869

3-01-258-10 - p-Xylene

Mixed Xylenes - 2869

3-01-258-15 - General
3-01-258-16 - Reactor
3-01-258-17 - Distillation Unit

Aromatics Production - 2869

3-01-258-80 - Fugitive Emissions: General
3-01-258-99 - Other Not Classified
(Specify in Comments)

Chlorobenzene - 2865

3-01-125-35 - General

3-01-301-01 - Tail Gas Scrubber
3-01-301-02 - Benzene Drying: Distillation
3-01-301-03 - Benzene Recovery
3-01-301-04 - Heavy-ends Processing
3-01-301-05 - MCB Distillation
3-01-301-06 - Vacuum System Vent
3-01-301-07 - DCB Crystallization

Chlorobenzene - 2865 (continued)

3-01-301-08 - DCB Crystal Handling/Loading
3-01-301-10 - Catalyst Incineration
3-01-301-80 - Fugitive Emissions: General

Carbon Tetrachloride - 2869

3-01-302-01 - General
3-01-302-02 - Distillation Vent
3-01-302-03 - Caustic Scrubber
3-01-302-80 - Fugitive Emissions: General

Allyl Chloride - 2869

3-01-303-01 - Chlorination Process: General
3-01-303-02 - HCL Absorber
3-01-303-03 - Light-ends Distillation Column
3-01-303-04 - Allyl Chloride Distillation Column
3-01-303-05 - Dichloropropene Distillation Column
3-01-303-80 - Fugitive Emissions: General

Allyl Alcohol - 2869

3-01-304-01 - General
3-01-304-02 - Catalyst Preparation
3-01-304-03 - Filtration System
3-01-304-04 - Light-ends Stripper
3-01-304-05 - Distillation System Condenser
3-01-304-80 - Fugitive Emissions: General

Epichlorohydrin - 2869

3-01-305-01 - General
3-01-305-02 - Epoxidation Reactor
3-01-305-03 - Azeotrope Column
3-01-305-04 - Light-ends Stripper
3-01-305-05 - Finishing Column
3-01-305-80 - Fugitive Emissions: General

General Processes - 2865, 2869

3-01-800-01 - Fugitive Leaks
3-01-810-01 - Air Oxidation Units
3-01-820-01 - Wastewater Separators
3-01-830-01 - Storage/Transfer
3-01-840-01 - Distillation Units

Inorganic Chemical Storage

Fixed Roof Tanks

3-01-870-01 - Hydrochloric Acid: Breathing Loss
3-01-870-02 - Hydrochloric Acid: Working Loss

3-01-870-03 - Hydrofluoric Acid: Breathing Loss
3-01-870-04 - Hydrofluoric Acid: Working Loss

3-01-870-05 - Nitric Acid: Breathing Loss
3-01-870-06 - Nitric Acid: Working Loss

3-01-870-07 - Phosphoric Acid: Breathing Loss
3-01-870-08 - Phosphoric Acid: Working Loss

3-01-870-09 - Sulfuric Acid: Breathing Loss
3-01-870-10 - Sulfuric Acid: Working Loss

3-01-870-97 - Specify Liquid: Breathing Loss
3-01-870-98 - Specify Liquid: Working Loss

Floating Roof Tanks

3-01-875-01 - Carbon Disulfide: Breathing Loss
3-01-875-02 - Carbon Disulfide: Working Loss

3-01-875-97 - Specify Liquid: Breathing Loss
3-01-875-98 - Specify Liquid: Working Loss

Inorganic Chemical Storage

Pressure Tanks

3-01-885-01 - Ammonia: Withdrawal Loss

3-01-885-02 - Carbon Monoxide: Withdrawal Loss

3-01-885-03 - Chlorine: Withdrawal Loss

3-01-885-04 - Hydrogen Cyanide: Withdrawal Loss

3-01-885-05 - Sulfur Dioxide: Withdrawal Loss

3-01-885-99 - Specify Gas: Withdrawal Loss

Chemical Manufacturing - Fugitive Emissions f

3-01-888-01 - Specify in Comments Field

3-01-888-02 - Specify in Comments Field

3-01-888-03 - Specify in Comments Field

3-01-888-04 - Specify in Comments Field

3-01-888-05 - Specify in Comments Field

Chemical Manufacturing - Fuel Fired Equipment

Process Heaters

3-01-900-01 - Distillate Oil (No. 2)

3-01-900-02 - Residual Oil

3-01-900-03 - Natural Gas

3-01-900-04 - Process Gas

Incinerators

3-01-900-11 - Distillate Oil (No. 2)

3-01-900-12 - Residual Oil

3-01-900-13 - Natural Gas

3-01-900-14 - Process Gas

Waste Gas Flares

3-01-900-99 - General

Chemical Manufacturing - Other Not Classified

3-01-999-98 - Specify in Comments

3-01-999-99 - Specify in Comments

FOOD AND AGRICULTURE -

MAJOR GROUPS 01, 02, 07, 20, 21, 42, 44, & 51

Alfalfa Dehydrating - 2048

3-02-001-02 - Primary CycTone & Dryer

3-02-001-03 - Meal Collector Cyclone

3-02-001-04 - Pellet Cooler Cyclone

Coffee Roasting - 2095

3-02-002-01 - Direct Fired Roaster

3-02-002-02 - Indirect Fired Roaster

3-02-002-03 - Stoner/Cooler

3-02-002-99 - Other Not Classified
(Specify in Comments)

Instant Coffee Products - 2095

3-02-003-01 - Spray Dryer

Cotton Ginning - 0724

3-02-004-01 - Unloading Fan

3-02-004-02 - Seed Cotton Cleaning System

3-02-004-03 - Stick/Burr Machine

3-02-004-04 - Miscellaneous (Lint Cleaner/
Battery Condensers/Master Trash/
Overflow/Mote Fans)

3-02-004-10 - General (Entire Process,
Alternative to Above)

Feed and Grain Terminal Elevators - 5153, 4221, 4463 Oat Milling - 2041

3-02-005-03 - Cleaning
3-02-005-04 - Drying
3-02-005-05 - Unloading (Receiving)
3-02-005-06 - Loading (Shipping)
3-02-005-07 - Removal from Bins (Tunnel Belt)
3-02-005-08 - Elevator Legs (Headhouse)
3-02-005-09 - Tripper (Gallery Belt)
3-02-005-10 - Removal from Bins (Tunnel Belt)

3-02-005-11 - Elevator Legs (Headhouse)

Feed and Grain Country Elevators - 5153, 4221

3-02-006-03 - Cleaning
3-02-006-04 - Drying
3-02-006-05 - Unloading
3-02-006-06 - Loading
3-02-006-07 - Removal from Bins
3-02-006-08 - Elevator Legs
3-02-006-09 - Removal from Bins

3-02-006-10 - Elevator Legs

Barley Milling - 2041

3-02-007-03 - Barley Cleaning
3-02-007-05 - Barley Flour Mill

Milo Milling - 2041

3-02-007-04 - Milo Cleaning

Durum Mills - 2041

3-02-007-11 - Grain Receiving
3-02-007-12 - Precleaning/Handling
3-02-007-13 - Cleaning House
3-02-007-14 - Millhouse

Rye Milling - 2041

3-02-007-21 - Grain Receiving
3-02-007-22 - Precleaning/Handling
3-02-007-23 - Cleaning House
3-02-007-24 - Millhouse

Wheat Mills - 2041

3-02-007-31 - Grain Receiving
3-02-007-32 - Precleaning/Handling
3-02-007-33 - Cleaning House
3-02-007-34 - Millhouse

Dry Corn Milling - 2041

3-02-007-41 - Grain Receiving
3-02-007-42 - Grain Drying
3-02-007-43 - Precleaning/Handling
3-02-007-44 - Cleaning House
3-02-007-45 - Degerming and Milling

Corn Wet Milling - 2046

3-02-007-51 - Grain Receiving
3-02-007-52 - Grain Handling
3-02-007-53 - Grain Cleaning
3-02-007-54 - Dryers
3-02-007-55 - Bulk Loading
3-02-007-56 - Milling

3-02-007-60 - General

Rice Milling - 2044

3-02-007-71 - Grain Receiving
3-02-007-72 - Precleaning/Handling
3-02-007-73 - Drying
3-02-007-74 - Cleaning and Millhouse

Soybean Mills - 2075, 2041

3-02-007-81 - Grain Receiving
3-02-007-82 - Grain Handling
3-02-007-83 - Grain Cleaning
3-02-007-84 - Drying
3-02-007-85 - Cracking & Dehulling
3-02-007-86 - Hull Grinding
3-02-007-87 - Bean Conditioning
3-02-007-88 - Flaking
3-02-007-89 - Meal Dryer
3-02-007-90 - Meal Cooler
3-02-007-91 - Bulk Loading

Feed Manufacture - 2048

3-02-008-02 - Grain Receiving
3-02-008-03 - Shipping
3-02-008-04 - Handling
3-02-008-05 - Grinding
3-02-008-06 - Pellet Coolers

Beer Production - 2082

3-02-009-01 - Grain Handling
3-02-009-02 - Drying Spent Grains
3-02-009-03 - Brewing
3-02-009-04 - Aging
3-02-009-05 - Malt Dryer

Whiskey Fermentation - 2085

3-02-010-01 - Grain Handling
3-02-010-02 - Drying Spent Grains
3-02-010-03 - Aging
3-02-010-04 - Fermentation Tank

Wines, Brandy, and Brandy Spirits - 2084

3-02-011-03 - Aging
3-02-011-04 - Fermentation: Tank
3-02-011-05 - Fermentation at 52° F
3-02-011-06 - Fermentation at 80° F
3-02-011-99 - Other Not Classified
(Specify in Comments)

Fish Processing - 2077, 2091

3-02-012-01 - Cookers-Fresh Fish Scrap
3-02-012-02 - Cookers-Stale Fish Scrap
3-02-012-04 - Canning Cookers
3-02-012-05 - Steam Tube Dryer
3-02-012-06 - Direct Fire Dryer

Meat Smokehouses - 2012, 2013

3-02-013-01 - Combined Operations

Starch Manufacturing - 2046

3-02-014-01 - Combined Operations

Sugar Cane Processing - 2061, 2062

3-02-015-99 - Other Not Classified
(Specify in Comments)

Sugar Beet Processing - 2063

3-02-016-01 - Dryer
3-02-016-99 - Other Not Classified
(Specify in Comments)

Peanut Processing - 2076, 2079, 2099

3-02-017-99 - Other Not Classified
(Specify in Comments)

Candy Manufacturing - 2065, 2066

3-02-018-99 - Other Not Classified
(Specify in Comments)

Vegetable Oil Processing - Specific Products/General
- 2046, 2074, 2076, 2079

3-02-019-01 - Corn Oil: General (2046)
3-02-019-02 - Cottonseed Oil: General (2074)
3-02-019-03 - Soybean Oil: General (2075)
3-02-019-04 - Coconut Oil: General (2076)
3-02-019-05 - Peanut Oil: General (2076)
3-02-019-99 - Other Not Classified (2076, 2079)
(Specify in Comments)

Vegetable Oil Processing - General Processes

for All Products - 2046, 2074, 2076, 2079

3-02-019-11 - Oil Extraction
3-02-019-12 - Meal Preparation
3-02-019-13 - Oil Refining
3-02-019-14 - Fugitive Leaks
3-02-019-15 - Solvent Storage

Beef Cattle Feed Lots - 0211

3-02-020-01 - Feed Lots - General
3-02-020-02 - Feed Lots - General

Cotton Seed Delinting - 0723

3-02-022-01 - Acid Delinting of Cotton Seeds

Seed Production and Processing - 0180, 5191

3-02-026-01 - Seed Handling - General

Mushroom Growing

3-01-028-01 - General

Dairy Products - 2021, 2022, 2023, 2024, 2026

3-02-030-01 - Milk Spray-Dryer
3-02-030-99 - Other Not Classified
(Specify in Comments)

Export Grain Elevators - 4463, 4221 0

3-02-031-03 - Cleaning
3-02-031-04 - Drying
3-02-031-05 - Unloading
3-02-031-06 - Loading
3-02-031-07 - Removal from Bins (Tunnel Belt)
3-02-031-08 - Elevator Legs
3-02-031-09 - Tripper (Gallery Belt)
3-02-031-10 - Removal from Bins (Tunnel Belt)

3-02-031-11 - Elevator Legs

Bakeries - 2051, 2052

3-02-032-01 - Bread Baking: Sponge-Dough Process
3-02-032-02 - Bread Baking: Straight-Dough Process
3-02-032-99 - Other Not Classified
(Specify in Comments)

Tobacco Processing - 2111, 2121, 2131, 2141

3-02-033-99 - Other Not Classified
(Specify in Comments)

Deep Fat Frying - 2099, 2017, 2051, 2092

3-02-036-01 - Cooking Vats: General

Food & Agriculture - Fugitive Emissions

3-02-888-01 - Specify in Comments Field
3-02-888-02 - Specify in Comments Field
3-02-888-03 - Specify in Comments Field
3-02-888-04 - Specify in Comments Field
3-02-888-05 - Specify in Comments Field

Food & Agriculture - Fuel Fired Equipment

Process Heaters

3-02-900-01 - Distillate Oil (No. 2)
3-02-900-02 - Residual Oil
3-02-900-03 - Natural Gas

Food & Agriculture - Other Not Classified

3-02-999-98 - Specify in Comments
3-02-999-99 - Specify in Comments

PRIMARY METAL PRODUCTION - MAJOR GROUPS 10 & 33

Aluminum Ore - Bauxite - 1051
3-03-000-01 - Crushing/Handling
3-03-000-02 - Drying Oven

Aluminum Ore: Electro-Reduction - 3334
3-03-001-01 - Prebaked Reduction Cell

3-03-001-02 - Horizontal Stud Soderberg Cell

3-03-001-03 - Vertical Stud Soderberg

3-03-001-04 - Materials Handling

3-03-001-05 - Anode Baking Furnace

3-03-001-06 - Degassing

3-03-001-07 - Roof Vents

3-03-001-08 - Prebake: Fugitive Emissions

3-03-001-09 - H.S.S.: Fugitive Emissions

3-03-001-10 - V.S.S.: Fugitive Emissions

3-03-001-11 - Anode Baking: Fugitive Emissions

Aluminum Hydroxide Calcining - 3334

3-03-002-01 - Overall Process

By-Product Coke Manufacturing - 3312

- 3-C3-003-02 - Oven Charging
- 3-C3-003-03 - Oven Pushing
- 3-C3-003-04 - Quenching
- 3-C3-003-05 - Coal Unloading
- 3-C3-003-06 - Oven Underfiring
- 3-C3-003-07 - Coal Crushing/Handling 9
- 3-C3-003-08 - Oven/Door Leaks
- 3-C3-003-09 - Coal Conveying
- 3-C3-003-10 - Coal Crushing
- 3-C3-003-11 - Coal Screening
- 3-C3-003-12 - Coke Crushing/Screening/Handling
- 3-C3-003-13 - Coal Preheater
- 3-C3-003-14 - Topside Leaks
- 3-C3-003-15 - Gas By-Product Plant
- 3-C3-003-16 - Coal Storage Pile

Coke Manufacture: Behives - 3312 r

- 3-C3-004-01 - General

Primary Copper Smelters - 3331

- 3-C3-005-02 - Multiple Hearth Roaster
- 3-C3-005-03 - Reverberatory Smelting Furnace after Roaster
- 3-C3-005-04 - Converter(All Configurations)
- 3-C3-005-05 - Fire (Furnace) Refining r
- 3-C3-005-06 - Ore Concentrate Dryer
- 3-C3-005-07 - Reverberatory Smelting Furnace with Ore Charging (w/o Roasting)
- 3-C3-005-08 - Refined Metal Finishing Operations
- 3-C3-005-09 - Fluidized-Bed Roaster
- 3-C3-005-10 - Electric Smelting Furnace
- 3-C3-005-11 - Electrolytic Refining
- 3-C3-005-12 - Flash Smelting
- 3-C3-005-13 - Roasting: Fugitive Emissions
- 3-C3-005-14 - Reverberatory Furnace: Fugitive Emissions
- 3-C3-005-15 - Converter: Fugitive Emissions
- 3-C3-005-16 - Anode Refining Furnace: Fugitive Emissions
- 3-C3-005-17 - Slag Cleaning Furnace: Fugitive Emissions
- 3-C3-005-18 - Converter Slag Return: Fugitive Emissions
- 3-C3-005-21 - Noranda Reactor
- 3-C3-005-22 - Slag Cleaning Furnace
- 3-C3-005-23 - Reverberatory Furnace w/ Convertor
- 3-C3-005-24 - Multi-Hearth Roaster w/ Reverberatory Furnace & Convertor or Fluid Bed Roaster w/ Electric Furnace & Convertor
- 3-C3-005-25 - Fluid Bed Roaster w/ Reverberatory Furnace & Convertor

- 3-03-005-26 - Dryer w/ Electric Furnace & Cleaning Furnace & Convertor
- 3-03-005-27 - Dryer w/ Flash Furnace & Convertor
- 3-03-005-28 - Dryer w/ Noranda Reactor & Convertor
- 3-03-005-99 - Other Not Classified (Specify in Comments)

Ferroalloy (Open Furnace) - 3313

- 3-03-006-01 - 50% FeSi: Electric Smelting Furnaces
- 3-03-006-02 - 75% FeSi: Electric Smelting Furnaces
- 3-03-006-03 - 90% FeSi: Electric Smelting Furnaces
- 3-03-006-04 - Silicon Metal: Electric Smelting Furnaces
- 3-03-006-05 - Silicomanganese: Electric Smelting Furnaces
- 3-03-006-10 - Ore Screening
- 3-03-006-11 - Ore Dryer
- 3-03-006-13 - Raw Materials Storage
- 3-03-006-14 - Raw Materials Transfer
- 3-03-006-15 - Ferromanganese: Blast Furnace
- 3-03-006-16 - Ferrosilicon: Blast Furnace
- 3-03-006-17 - Cast House
- 3-03-006-99 - Other Not Classified (Specify in Comments)

Ferroalloy (Semi-covered Furnace) - 3313

- 3-03-007-01 - Ferromanganese: Electric Arc Furnace
- 3-03-007-02 - Electric Arc Furnace (Other Alloys Specify in Comments)
- 3-03-007-03 - Ferrochromium - Electric Arc Furnace
- 3-03-007-04 - Ferrochromium Silicon - Electric Arc Furnace

Iron Production - 3312

- 3-03-008-01 - Blast Furnace: Ore Charge
- 3-03-008-02 - Blast Furnace: Agglomerates Charge

Blast Furnace Slag

- 3-03-008-04 - Loader: Hi-Silt
- 3-03-008-05 - Loader: Lo-Silt
- 3-03-008-08 - Slag Crushing and Sizing
- 3-03-008-09 - Slag Removal and Dumping

Sintering - 3312

- 3-03-008-11 - Raw Material Stockpiles, Coke Breeze, Limestone, Ore Fines
- 3-03-008-12 - Raw Material Transfer/Handling
- 3-03-008-13 - Windbox
- 3-03-008-14 - Sinter Discharge End
- 3-03-008-15 - Sinter Breaker
- 3-03-008-16 - Sinter Hot Screening
- 3-03-008-17 - Sinter Cooler
- 3-03-008-18 - Sinter Cold Screening
- 3-03-008-19 - Sinter Processing (Combined Code Includes 15, 16, 17, 18)
- 3-03-008-20 - Sinter Conveyor: Transfer Station
- 3-03-008-21 - Unloading Ore, Pellets, Limestone into Blast Furnace
- 3-03-008-22 - Blast Furnace Raw Materials Stockpiles: Ore, Pellets, Limestone, Coke, Sinter

3-03-008-23 - Blast Furnace Charge Materials Transfer/Handling
3-03-008-24 - Blast Heating Stoves
3-03-008-25 - Cast House
3-03-008-26 - Blast Furnace Slips
3-03-008-27 - Lump Ore Unloading

Fugitive Emissions: Roads

3-03-008-31 - Unpaved Roads: LDV
3-03-008-32 - Unpaved Roads: MDV
3-03-008-33 - Unpaved Roads: HDV
3-03-008-34 - Paved Roads: All

Steel Production - 3312

3-03-009-01 - Open Hearth Furnace: Stack
3-03-009-04 - Electric Arc Furnace: Stack (Alloy Steel)
3-03-009-06 - Charging: EAF
3-03-009-07 - Tapping: EAF
3-03-009-08 - Electric Arc Furnace: Stack (Carbon Steel)
3-03-009-10 - Pickling
3-03-009-11 - Soaking Pits
3-03-009-12 - Grinding
3-03-009-13 - Basic Oxygen Furnace: Open Hood - Stack
3-03-009-14 - Basic Oxygen Furnace: Closed Hood - Stack
3-03-009-15 - Hot Metal (Iron) Transfer to Steelmaking Furnace
3-03-009-16 - Charging: BOF
3-03-009-17 - Tapping: BOF
3-03-009-18 - Charging: Open Hearth
3-03-009-19 - Tapping: Open Hearth
3-03-009-21 - Teeming (Unleaded Steel)
3-03-009-22 - Continuous Casting
3-03-009-23 - Steel Furnace Slag Tapping and Dumping
3-03-009-24 - Steel Furnace Slag Processing, Crushing and Sizing
3-03-009-25 - Teeming (Leaded Steel)
3-03-009-31 - Hot Rolling
3-03-009-32 - Machine Scarfing
3-03-009-33 - Reheat Furnaces
3-03-009-34 - Heat Treating Furnaces, Annealing
3-03-009-35 - Cold Rolling
3-03-009-36 - Coating (Tin, Zinc, etc.)
3-03-009-98 - Other Not Classified (Specify in Comments)
3-03-009-99 - Other Not Classified (Specify in Comments)

Lead Smelters - 3332

3-03-010-01 - Sintering: Single Stream
3-03-010-02 - Blast Furnace Operation
3-03-010-03 - Dross Reverberatory Furnace
3-03-010-04 - Ore Crushing
3-03-010-05 - Materials Handling (Includes 11, 12, 13, 04, 14)
3-03-010-06 - Sintering: Dual Stream Feed End
3-03-010-07 - Sintering: Dual Stream Discharge End

3-03-010-08 - Slag Fume Furnace
3-03-010-09 - Lead Drossing
3-03-010-10 - Crushing & Grinding
3-03-010-11 - Raw Material Unloading
3-03-010-12 - Raw Material Storage Piles
3-03-010-13 - Raw Material Transfer
3-03-010-14 - Sintering Charge Mixing
3-03-010-15 - Sinter Crushing/Screening
3-03-010-16 - Sinter Transfer
3-03-010-17 - Sinter Fines Return Handling
3-03-010-18 - Blast Furnace Charging
3-03-010-19 - Blast Furnace Tapping (Metal and Slag)
3-03-010-20 - Blast Furnace Lead Pouring
3-03-010-21 - Blast Furnace Slag Pouring
3-03-010-22 - Lead Refining/Silver Retort Building
3-03-010-23 - Lead Casting
3-03-010-24 - Reverberatory or Kettle Softening
3-03-010-25 - Sinter Machine Leakage
3-03-010-26 - Sinter Dump Area

Molybdenum Ore Mining - 1061

3-03-011-01 - Mining: General
3-03-011-02 - Milling: General
3-03-011-99 - Processing (Specify in Comments)

Titanium Processing - 3339, 3369, 3356

3-03-012-01 - Chlorination
3-03-012-02 - Drying Titanium Sand Ore (Cyclone Exit)
3-03-012-99 - Other Not Classified (Specify in Comments)

Gold Processing - 1041, 3341, 3339

3-03-013-01 - Mining/Processing

Barium Ore Processing - 3295

3-03-014-01 - Ore Grinding
3-03-014-02 - Reduction Kiln
3-03-014-03 - Dryers/Calciners
3-03-014-99 - Others Not Classified (Specify in Comments)

Taconite Iron Ore Processing - 1011

3-03-023-01 - Primary Crushing
3-03-023-02 - Fines Crushing
3-03-023-03 - Ore Screening
3-03-023-04 - Ore Transfer
3-03-023-05 - Ore Storage
3-03-023-06 - Dry Grinding/Milling
3-03-023-07 - Bentonite Storage
3-03-023-08 - Bentonite Blending
3-03-023-09 - Traveling Grate Feed
3-03-023-10 - Traveling Grate Discharge
3-03-023-11 - Chip Regrinding
3-03-023-12 - Indurating Furnace: Gas Fired
3-03-023-13 - Indurating Furnace: Oil Fired

Taconite Iron Ore Processing - 1011 (continued)

- 3-03-023-14 - Indurating Furnace: Coal Fired
- 3-03-023-15 - Pellet Cooler
- 3-03-023-16 - Pellet Transfer
- 3-03-023-21 - Haul Road: Rock

- 3-03-023-22 - Haul Road: Taconite

Metal Mining - General Processes - 1011-1099 W

- 3-03-024-01 - Primary Crushing (low moisture ore)
- 3-03-024-02 - Secondary Crushing (low moisture ore)
- 3-03-024-03 - Tertiary Crushing (low moisture ore)
- 3-03-024-04 - Material Handling (low moisture ore)
- 3-03-024-05 - Primary Crushing (high moisture ore)
- 3-03-024-06 - Secondary Crushing (high moisture ore)
- 3-03-024-07 - Tertiary Crushing (high moisture ore)
- 3-03-024-08 - Material Handling (high moisture ore)
- 3-03-024-09 - Dry Grinding w/air conveying
- 3-03-024-10 - Dry Grinding w/o air conveying, etc.
- 3-03-024-11 - Ore Drying

Zinc Smelting - 3333

- 3-03-030-02 - Multiple Hearth Roaster
- 3-03-030-03 - Sinter Strand
- 3-03-030-05 - Vertical Retort/Electro-thermal Furnace
- 3-03-030-06 - Electrolytic Processor
- 3-03-030-07 - Flash Roaster
- 3-03-030-08 - Fluid Bed Roaster
- 3-03-030-09 - Raw Material Handling and Transfer
- 3-03-030-10 - Sinter Breaking and Cooling
- 3-03-030-11 - Zinc Casting
- 3-03-030-12 - Raw Material Unloading
- 3-03-030-14 - Crushing/Screening
- 3-03-030-15 - Zinc Melting
- 3-03-030-16 - Alloying

Primary Metal Industries - Fuel Fired Equipment**Process Heaters**

- 3-03-900-01 - Distillate Oil (No. 2)
- 3-03-900-02 - Residual Oil
- 3-03-900-03 - Natural Gas
- 3-03-900-04 - Process Gas

Incinerators

- 3-03-900-11 - Distillate Oil (No. 2)
- 3-03-900-12 - Residual Oil
- 3-03-900-13 - Natural Gas
- 3-03-900-14 - Process Gas

Flares

- 3-03-900-21 - Distillate Oil (No. 2)
- 3-03-900-22 - Residual Oil
- 3-03-900-23 - Natural Gas
- 3-03-900-24 - Process Gas

Primary Metal Production - Fugitive Emissions

- 3-03-888-01 - Specify in Comments Field
- 3-03-888-02 - Specify in Comments Field
- 3-03-888-03 - Specify in Comments Field
- 3-03-888-04 - Specify in Comments Field
- 3-03-888-05 - Specify in Comments Field

Primary Metal Industries: Other Not Classified

- 3-03-999-99 - Other Not Classified
(Specify in Comments)

SECONDARY METAL PRODUCTION - MAJOR GROUPS 33 & 34**Secondary Aluminum - 3341, 3353, 3354, 3355, 3361, 3411, 3497**

- 3-04-001-01 - Sweating Furnace
- 3-04-001-02 - Smelting Furnace/Crucible
- 3-04-001-03 - Smelting Furnace/Reverberatory
- 3-04-001-04 - Fluxing (Chlorination)

3-04-001-05 - Fluxing (Fluoridation)**3-04-001-06 - Degassing****3-04-001-07 - Hot Dross Processing****3-04-001-08 - Crushing/Screening****3-04-001-09 - Burning/Drying****3-04-001-10 - Foil Rolling****3-04-001-11 - Foil Converting****3-04-001-12 - Annealing Furnace****3-04-001-13 - Slab Furnace****3-04-001-20 - Can Manufacture****3-04-001-50 - Rolling/Drawing/Extruding****Secondary Copper Smelting and Alloying****(Brass/Bronze Melt) - 3341, 3362****3-04-002-07 - Scrap Dryer (Rotary)****3-04-002-08 - Wire Burning (Incinerator)****3-04-002-09 - Sweating Furnace****Cupolas****3-04-002-10 - Charge w/Scrap Copper****3-04-002-11 - Charge w/Insulated Copper Wire****3-04-002-12 - Charge w/Scrap Copper and Brass****Reverberatory Furnace****3-04-002-14 - Charge w/Copper****3-04-002-15 - Charge w/Brass and Bronze****Rotary Furnace****3-04-002-17 - Charge w/Brass and Bronze****Crucible and Pot Furnaces****3-04-002-19 - Charge w/Brass and Bronze****Electric Arc Furnace****3-04-002-20 - Charge w/Copper****3-04-002-21 - Charge w/Brass and Bronze****Electric Induction Furnace****3-04-002-23 - Charge w/Copper****3-04-002-24 - Charge w/Brass and Bronze****Fugitive Emissions****3-04-002-30 - Scrap Metal Pretreatment****3-04-002-31 - Scrap Dryer****3-04-002-32 - Wire Incinerator****3-04-002-33 - Sweating Furnace****3-04-002-34 - Cupola Furnace****3-04-002-35 - Reverberatory Furnace****3-04-002-36 - Rotary Furnace****3-04-002-37 - Crucible Furnace****3-04-002-38 - Electric Induction Furnace****3-04-002-39 - Casting Operations****3-04-002-99 - Other Not Classified
(Specify in Comments)**

Gray Iron Foundries - 3321

- 3-04-003-01 - Cupola
- 3-04-003-02 - Reverberatory Furnace
- 3-04-003-03 - Electric Induction Furnace
- 3-04-003-04 - Electric Arc Furnace
- 3-04-003-05 - Annealing Operating
- 3-04-003-10 - Inoculation
- 3-04-003-15 - Charge Handling
- 3-04-003-20 - Pouring/Casting
- 3-04-003-25 - Castings Cooling
- 3-04-003-31 - Casting Shakeout
- 3-04-003-32 - Casting Knockout
- 3-04-003-33 - Shakeout Machine
- 3-04-003-40 - Castings Grinding/Cleaning
- 3-04-003-41 - Casting Cleaning/Tumblers
- 3-04-003-42 - Casting Cleaning/Chippers
- 3-04-003-50 - Sand Grinding/Handling
- 3-04-003-51 - Core Ovens
- 3-04-003-52 - Sand Grinding/Handling
- 3-04-003-53 - Core Ovens
- 3-04-003-54 - Core Ovens
- 3-04-003-55 - Sand Dryer
- 3-04-003-56 - Sand Silo
- 3-04-003-57 - Conveyors/Elevators
- 3-04-003-58 - Sand Screens
- 3-04-003-60 - Castings Finishing
- 3-04-003-70 - Shell Core Machine
- 3-04-003-71 - Core Machines/Other
- 3-04-003-98 - Other Not Classified
(Specify in Comments)
- 3-04-003-99 - Other Not Classified
(Specify in Comments)

Secondary Lead Smelting - 3341, 3369

- 3-04-004-01 - Pot Furnace
- 3-04-004-02 - Reverberatory Furnace
- 3-04-004-03 - Blast Furnace (Cupola)
- 3-04-004-04 - Rotary Sweating Furnace
- 3-04-004-05 - Reverberatory Sweating Furnace
- 3-04-004-06 - Pot Furnace Heater:
Distillate Oil
- 3-04-004-07 - Pot Furnace Heater:
Natural Gas
- 3-04-004-08 - Barton Process Reactor
(Oxidation Kettle)
- 3-04-004-09 - Casting

Secondary Lead Smelting - 3341, 3369

- 3-04-004-10 - Battery Breaking
- 3-04-004-11 - Scrap Crushing
- 3-04-004-12 - Sweating Furnace: Fugitive
- 3-04-004-13 - Sweating Furnace: Fugitive
- 3-04-004-14 - Kettle Refining: Fugitive
- 3-04-004-99 - Other Not Classified
(Specify in Comments)

Lead Battery Manufacture - 3691

- 3-04-005-05 - Overall Process
- 3-04-005-06 - Grid Casting
- 3-04-005-07 - Paste Mixing
- 3-04-005-08 - Lead Oxide Mill
(Baghouse Outlet)
- 3-04-005-09 - Three Process Operation
- 3-04-005-10 - Lead Reclaiming Furnace
- 3-04-005-11 - Small Parts Casting
- 3-04-005-12 - Formation
- 3-04-005-99 - Other Not Classified
(Specify in Comments)

Magnesium - 3341

- 3-04-006-01 - Pot Furnace
- 3-04-006-99 - Other Not Classified
(Specify in Comments)

Steel Foundry - 3324, 3325

- 3-04-007-01 - Electric Arc Furnace
- 3-04-007-02 - Open Hearth Furnace
- 3-04-007-03 - Open Hearth Furnace with
Oxygen Lance
- 3-04-007-04 - Heat-Treating Furnace
- 3-04-007-05 - Electric Induction Furnace
- 3-04-007-06 - Sand Grinding/Handling in Mold
and Core Making
- 3-04-007-07 - Core Ovens
- 3-04-007-08 - Pouring and Casting
- 3-04-007-09 - Casting Shakeout
- 3-04-007-10 - Casting Knockout
- 3-04-007-11 - Castings Cleaning
- 3-04-007-12 - Charge Handling
- 3-04-007-13 - Castings Cooling
- 3-04-007-14 - Shakeout Machine
- 3-04-007-15 - Finishing: Specify in Comments
- 3-04-007-16 - Sand Grinding and Handling
- 3-04-007-17 - Core Ovens
- 3-04-007-18 - Core Ovens
- 3-04-007-20 - Sand Dryer
- 3-04-007-21 - Sand Silo
- 3-04-007-22 - Muller
- 3-04-007-23 - Conveyors/Elevators
- 3-04-007-24 - Sand Screens
- 3-04-007-25 - Casting Cleaning/Tumblers
- 3-04-007-26 - Casting Cleaning/Chippers
- 3-04-007-30 - Shell Core Machine
- 3-04-007-31 - Core Machines/Other
- 3-04-007-99 - Other Not Classified
(Specify in Comments)

Secondary Zinc Production - 3341

- 3-04-008-01 - Retort Furnace
- 3-04-008-02 - Horizontal Muffle Furnace
- 3-04-008-03 - Pot Furnace
- 3-04-008-05 - Galvanizing Kettle
- 3-04-008-06 - Calcining Kiln
- 3-04-008-07 - Concentrate Dryer
- 3-04-008-09 - Rotary Sweat Furnace
- 3-04-008-10 - Muffle Sweat Furnace
- 3-04-008-11 - Electric Resistance Sweat Furnace
- 3-04-008-12 - Crushing/Screening of Zinc Residues
- 3-04-008-14 - Kettle-Sweat Furnace (Clean
Metallic Scrap)
- 3-04-008-18 - Reverberatory Sweat Furnace
(Clean Metallic Scrap)
- 3-04-008-24 - Kettle-Sweat Furnace (General
Metallic Scrap)
- 3-04-008-28 - Reverberatory Sweat Furnace
(General Metallic Scrap)
- 3-04-008-34 - Kettle-Sweat Furnace
(Residual Scrap)
- 3-04-008-38 - Reverberatory Sweat Furnace
(Residual Scrap)
- 3-04-008-40 - Alloying
- 3-04-008-41 - Scrap Melting: Crucible
- 3-04-008-42 - Scrap Melting: Reverberatory
Furnace
- 3-04-008-43 - Scrap Melting: Electric
Induction Furnace

3-04-008-51 - Retort & Muffle Distillation:
Pouring
3-04-008-52 - Retort & Muffle Distillation:
Casting
3-04-008-53 - Graphite Rod Distillation:
3-04-008-54 - Retort Distillation/Oxidation

3-04-008-55 - Muffle Distillation/Oxidation

Secondary Zinc Production - Fugitive Emissions

- 3341

3-04-008-61 - Reverberatory Sweating
3-04-008-62 - Rotary Sweating
3-04-008-63 - Muffle Sweating
3-04-008-64 - Kettle (Pot) Sweating
3-04-008-65 - Electric Resistance Sweating
3-04-008-66 - Sodium Carbonate Leaching
3-04-008-67 - Kettle (Pot) Melting Furnace
3-04-008-68 - Crucible Melting Furnace
3-04-008-69 - Reverberatory Melting Furnace
3-04-008-70 - Electric Induction Melting
3-04-008-71 - Alloying Retort Distillation
3-04-008-72 - Retort and Muffle Distillation
3-04-008-73 - Casting
3-04-008-74 - Graphite Rod Distillation
3-04-008-75 - Retort Distillation/Oxidation
3-04-008-76 - Muffle Distillation/Oxidation
3-04-008-77 - Retort Reduction
3-04-008-99 - Other Not Classified
(Specify in Comments)

Malleable Iron - 3322

3-04-009-01 - Annealing
3-04-009-99 - Other Not Classified
(Specify in Comments)

Nickel - 3341

3-04-010-01 - Flux Furnace
3-04-010-99 - Other Not Classified
(Specify in Comments)

Furnace Electrode Manufacture - 3624

3-04-020-01 - Calcination
3-04-020-02 - Mixing
3-04-020-03 - Pitch Treating
3-04-020-04 - Bake Furnaces
3-04-020-99 - Other Not Classified
(Specify in Comments)

Metal Heat Treating - 3398

3-04-022-01 - Furnace: General
3-04-022-10 - Quench Bath

Lead Cable Coating - 3357, 3315

3-04-040-01 - General

Miscellaneous Casting and Fabricating - 3300-3399

3-04-049-01 - Wax Burnout Oven

3-04-050-01 - Other Not Classified
(Specify in Comments)
3-04-050-99 - Other Not Classified
(Specify in Comments)

Secondary Metal Production - Fugitive Emissions

3-04-888-01 - Specify in Comments Field
3-04-888-02 - Specify in Comments Field
3-04-888-03 - Specify in Comments Field
3-04-888-04 - Specify in Comments Field
3-04-888-05 - Specify in Comments Field

Secondary Metal Production - Fuel Fired Equipment

Process Heaters

3-04-900-01 - Distillate Oil (No. 2)
3-04-900-02 - Residual Oil
3-04-900-03 - Natural Gas
3-04-900-04 - Process Gas

Incinerators

3-04-900-11 - Distillate Oil (No. 2)
3-04-900-12 - Residual Oil
3-04-900-13 - Natural Gas
3-04-900-14 - Process Gas

Flares

3-04-900-21 - Distillate Oil (No. 2)
3-04-900-22 - Residual Oil
3-04-900-23 - Natural Gas
3-04-900-24 - Process Gas

Secondary Metal Production - Other Not Classified

3-04-999-99 - Other Not Classified
(Specify in Comments)

MINERAL PRODUCTS - MAJOR GROUPS 11, 12, 14, 28, 29, 32, 44

Asphalt Roofing Manufacture - 2952

3-05-001-01 - Asphalt Blowing: Saturant
3-05-001-02 - Asphalt Blowing: Coating
3-05-001-03 - Felt Saturation: Dipping Only
3-05-001-04 - Felt Saturation:
Dipping/Spraying
3-05-001-10 - Blowing
3-05-001-11 - Dipping Only
3-05-001-12 - Spraying Only
3-05-001-13 - Dipping/Spraying
3-05-001-98 - Not Classified
(Specify in Comments)

Asphaltic Concrete - 2951

3-05-002-01 - Rotary Dryer, Conventional Plant
3-05-002-02 - Hot Elevators, Screens, Bins & Mixer
3-05-002-03 - Storage Piles
3-05-002-04 - Cold Aggregate Handling
3-05-002-05 - Drum, Dryer Hot Asphalt Plants
3-05-002-06 - Asphalt Heater (Natural Gas)
3-05-002-07 - Asphalt Heater (Residual Oil)
3-05-002-08 - Asphalt Heater (Distillate Oil)

Brick Manufacturing - 3251

3-05-003-01 - Raw Material Drying
3-05-003-02 - Raw Material Grinding
3-05-003-03 - Storage of Raw Materials
3-05-003-07 - Process Calcining
3-05-003-08 - Screening
3-05-003-09 - Process Blending and Mixing
3-05-003-11 - Curing and Firing: Gas-Fired
Tunnel Kilns
3-05-003-12 - Curing and Firing: Oil-Fired
Tunnel Kilns

Brick Manufacturing - 3251 (continued)
3-05-003-13 - Curing and Firing: Coal-Fired Tunnel Kilns
3-05-003-14 - Curing and Firing: Gas-Fired Periodic Kilns
3-05-003-15 - Curing and Firing: Oil-Fired Periodic Kilns
3-05-003-16 - Curing and Firing: Coal-Fired Periodic Kilns
3-05-003-98 - Other Not Classified (Specify in Comments)

Calcium Carbide - 2819
3-05-004-01 - Electric Furnace (Hoods & Main Stack)
3-05-004-02 - Coke Dryer
3-05-004-03 - Furnace Room Vents
3-05-004-04 - Tap Fume Vents
3-05-004-05 - Primary Secondary/Crushing
3-05-004-06 - Circular Charging: Conveyor

Castable Refractory - 3255
3-05-005-01 - Raw Material Dryer
3-05-005-02 - Raw Material Crushing/Processing
3-05-005-03 - Electric Arc Melt
3-05-005-04 - Curing Oven
3-05-005-05 - Molding and Shakeout
3-05-005-98 - Other Not Classified (Specify in Comments)
3-05-005-99 - Other Not Classified (Specify in Comments)

Cement Manufacturing - Dry Process - 3241
3-05-006-06 - Kilns dd
3-05-006-07 - Raw Material Unloading
3-05-006-08 - Raw Material Piles
3-05-006-09 - Primary Crushing
3-05-006-10 - Secondary Crushing
3-05-006-11 - Screening
3-05-006-12 - Raw Material Transfer
3-05-006-13 - Raw Material Grinding and Drying
3-05-006-14 - Clinker Cooler
3-05-006-15 - Clinker Piles
3-05-006-16 - Clinker Transfer
3-05-006-17 - Clinker Grinding
3-05-006-18 - Cement Silos
3-05-006-19 - Cement Load Out

Wet Process - 3241
3-05-007-06 - Kilns dd
3-05-007-07 - Raw Material Unloading
3-05-007-08 - Raw Material Piles
3-05-007-09 - Primary Crushing
3-05-007-10 - Secondary Crushing
3-05-007-11 - Screening
3-05-007-12 - Raw Material Transfer
3-05-007-14 - Clinker Cooler
3-05-007-15 - Clinker Piles
3-05-007-16 - Clinker Transfer
3-05-007-17 - Clinker Grinding
3-05-007-18 - Cement Silo
3-05-007-19 - Cement Loadout

Ceramic Clay Manufacturing - 3261
3-05-008-01 - Drying
3-05-008-02 - Grinding
3-05-008-03 - Storage
3-05-008-99 - Other Not Classified (Specify in Comments)

Clay and Fly Ash Sintering (Low Density Aggregate Manufacture) - 3295
3-05-009-01 - Fly Ash Sintering
3-05-009-02 - Clay/Coke Sintering
3-05-009-03 - Natural Clay/Shale Sintering
3-05-009-04 - Raw Clay/Shale Crushing/Screening
3-05-009-05 - Raw Clay/Shale Transfer/Conveying
3-05-009-06 - Raw Clay/Shale Storage Piles
3-05-009-07 - Sintered Clay/Coke Product Crushing and Screening
3-05-009-08 - Sintered Clay/Shale Product Crushing and Screening
3-05-009-09 - Expanded Shale Clinker Cooling
3-05-009-10 - Expanded Shale Storage
3-05-009-99 - Other Not Classified (Specify in Comments)

Coal Cleaning - 1111, 1211 ee

Thermal Dryer - 1111, 1211 ee
3-05-010-01 - Fluidized Bed
3-05-010-02 - Flash or Suspension
3-05-010-03 - Multilouvered
3-05-010-04 - Rotary
3-05-010-05 - Cascade
3-05-010-06 - Continuous Carrier
3-05-010-07 - Screen

Material Handling - 1111, 1211 ee
3-05-010-08 - Unloading
3-05-010-09 - Raw Coal Storage
3-05-010-10 - Crushing
3-05-010-11 - Coal Transfer
3-05-010-12 - Screening
3-05-010-13 - Air Tables
3-05-010-14 - Cleaned Coal Storage
3-05-010-15 - Loading
3-05-010-16 - Loading: Clean Coal
3-05-010-17 - Secondary Crushing

Surface Mining Operations - 1111, 1211

3-05-010-21 - Overburden Removal
3-05-010-22 - Drilling/Blasting
3-05-010-23 - Loading
3-05-010-24 - Hauling
3-05-010-30 - Topsoil Removal
3-05-010-31 - Scrapers: Travel Mode
3-05-010-32 - Topsoil Unloading
3-05-010-33 - Overburden: Drilling
3-05-010-34 - Coal Seam: Drilling
3-05-010-35 - Blasting: Coal Overburden
3-05-010-36 - Dragline: Overburden Removal
3-05-010-37 - Truck Loading: Overburden
3-05-010-38 - Truck Loading: Coal
3-05-010-39 - Hauling: Haul Trucks
3-05-010-40 - Truck Unloading: End Dump-Coal
3-05-010-41 - Truck Unloading: Bottom Dump-Coal
3-05-010-42 - Truck Unloading: Bottom Dump-Overburden
3-05-010-43 - Open Storage Pile: Coal
3-05-010-44 - Train Loading: Coal
3-05-010-45 - Bulldozing: Overburden
3-05-010-46 - Bulldozing: Coal
3-05-010-47 - Grading
3-05-010-48 - Overburden Replacement
3-05-010-49 - Wind Erosion: Exposed Areas

Concrete Batching - 3271, 3272, 3273, 3275, 1771, 3292
3-05-011-01 - General (Non-Fugitive) 0.2

3-05-011-12 - Mixing: Wet

3-05-011-13 - Mixing: Dry

3-05-011-14 - Transferring: Conveyors/Elevators

3-05-011-15 - Storage: Bins/Hoppers

3-05-010-50 - Vehicle Traffic: Light/
Medium Vehicles

3-05-010-90 - Haul Roads: General

3-05-010-99 - Other Not Classified
(Specify in Comments)

Concrete Batching - Fugitive Emissions

- 3271, 3272, 3273, 3275, 1771, 3292

3-05-011-06 - Transfer of Sand and
Aggregate to Elevated Bins

3-05-011-07 - Cement Unloading to
Storage Bins

3-05-011-08 - Weight Hopper Loading of
Cement, Sand and Aggregate

3-05-011-09 - Mixer Loading of Cement,
Sand, and Aggregate

3-05-011-10 - Loading of Transit Mix Truck

3-05-011-11 - Loading of Dry-Batch Truck

3-05-011-20 - Asbestos/Cement Products

3-05-011-99 - Other Not Classified
(Specify in Comments)

Fiberglass Manufacturing - 3229, 3296

Wool-Type Glass Fiber - 3296

3-05-012-01 - Regenerative Furnace

3-05-012-02 - Recuperative Furnace

3-05-012-03 - Electric Furnace

3-05-012-04 - Forming (Rotary Spun)

3-05-012-05 - Curing Oven (Rotary Spun)

3-05-012-06 - Cooling

3-05-012-07 - Unit Melter Furnace

3-05-012-08 - Forming (Flame Attenuation)

3-05-012-09 - Curing (Flame Attenuation)

Textile-Type Glass Fiber - 3229

3-05-012-11 - Regenerative Furnace

3-05-012-12 - Recuperative Furnace

3-05-012-13 - Unit Melter Furnace

3-05-012-14 - Forming Process

3-05-012-15 - Curing Oven

3-05-012-21 - Raw Material Unloading/
Conveying

3-05-012-22 - Raw Material Storage Bins

3-05-012-23 - Raw Material Mixing/Weighing

3-05-012-24 - Raw Material Crushing/Charging

3-05-012-99 - Other Not Classified
(Specify in Comments)

Frit Manufacture - 2899

3-05-013-01 - Rotary Furnace

3-05-013-99 - Other Not Classified
(Specify in Comments)

Glass Manufacture - 3211, 3221, 3229

3-05-014-02 - Container Glass: Melting
Furnace

3-05-014-03 - Flat Glass: Melting
Furnace

3-05-014-04 - Pressed and Blown Glass:
Melting Furnace

3-05-014-06 - Container Glass: Forming &
Finishing

3-05-014-07 - Flat Glass: Forming &
Finishing

3-05-014-08 - Pressed and Blown Glass:
Forming & Finishing

3-05-014-10 - Raw Material Handling
(All Types of Glass)

3-05-014-13 - Cullet Crushing/Grinding

3-05-014-14 - Ground Cullet Beading Furnace

3-05-014-15 - Glass Etching with Hydro-
fluoric Acid Solution

Gypsum Manufacture - 3275

3-05-015-01 - Rotary Ore Dryer

3-05-015-02 - Primary Grinder/Roller Mills

3-05-015-04 - Conveying

3-05-015-05 - Primary Crushing: Gypsum Ore

3-05-015-06 - Secondary Crushing: Gypsum Ore

3-05-015-07 - Screening: Gypsum Ore

3-05-015-08 - Stockpile: Gypsum Ore

3-05-015-09 - Storage Bins: Gypsum Ore

3-05-015-10 - Storage Bins: Landplaster

3-05-015-11 - Continuous Kettle: Calciner

3-05-015-12 - Flash Calciner

3-05-015-13 - Impact Mill

3-05-015-14 - Storage Bins: Stucco

3-05-015-15 - Tube/Ball Mills

3-05-015-16 - Mixers

3-05-015-17 - Bagging

3-05-015-18 - Mixers/Conveyor

3-05-015-19 - Forming Line

3-05-015-20 - Drying Kiln

3-05-015-21 - End Sawing (8 Ft)

3-05-015-22 - End Sawing (12 Ft)

Lime Manufacture - 3274

3-05-016-01 - Primary Crushing

3-05-016-02 - Secondary Crushing/Screening

3-05-016-03 - Calcining-Vertical Kiln dd

3-05-016-04 - Calcining-Rotary Kiln dd

3-05-016-05 - Calcimatic Kiln dd

3-05-016-06 - Fluidized Bed Kiln dd

3-05-016-07 - Raw Material Transfer
and Conveying

3-05-016-08 - Raw Material Unloading

3-05-016-09 - Hydrator (Atmospheric)

3-05-016-10 - Raw Material Storage Piles

3-05-016-11 - Product Cooler
3-05-016-12 - Pressure Hydrator

3-05-016-13 - Lime Silos
3-05-016-14 - Packing/Shipping
3-05-016-15 - Produce Transfer and Conveying
3-05-016-16 - Primary Screening
3-05-016-17 - Multiple Hearth Calciner

Mineral Wool - 3296
3-05-017-01 - Cupola
3-05-017-02 - Reverberatory Furnace
3-05-017-03 - Blow Chamber
3-05-017-04 - Curing Oven
3-05-017-05 - Cooler
3-05-017-99 - Other Not Classified
(Specify in Comments)

Perlite Manufacture - 3295
3-05-018-01 - Vertical Furnace
3-05-018-99 - Other Not Classified
(Specify in Comments)

Phosphate Rock - 1475
3-05-019-01 - Drying
3-05-019-02 - Grinding
3-05-019-03 - Transfer/Storage
3-05-019-04 - Open Storage
3-05-019-05 - Calcining
3-05-019-99 - Other Not Classified
(Specify in Comments)

Stone Quarrying/Processing
- 1411, 1422, 1423, 1429, 1499
3-05-020-01 - Primary Crushing
3-05-020-02 - Secondary Crush/Screen
3-05-020-03 - Tertiary Crush/Screen
3-05-020-04 - Recrush/Screening
3-05-020-05 - Fines Mill
3-05-020-06 - Miscellaneous Operation-
Screen/Convey/Handling
3-05-020-07 - Open Storage
3-05-020-08 - Cut Stone - General
3-05-020-09 - Blasting - General
3-05-020-10 - Drilling
3-05-020-11 - Hauling
3-05-020-12 - Drying
3-05-020-13 - Bar Grizzlies
3-05-020-14 - Shaker Screens
3-05-020-15 - Vibrating Screens
3-05-020-16 - Revolving Screens
3-05-020-20 - Drilling

Salt Mining - 1476
3-05-021-01 - General
3-05-021-02 - Granulation: Stack Dryer
3-05-021-03 - Filtration: Vacuum Filter
3-05-021-04 - Crushing
3-05-021-05 - Screening
3-05-021-06 - Conveying

Potash Production - 1474
3-05-022-01 - Mine - GrInd/Dry
3-05-022-99 - Other Not Classified
(Specify in Comments)

Magnesium Carbonate - 1459
3-05-024-01 - Mine/Process
3-05-024-99 - Other Not Classified
(Specify in Comments)

Sand/Gravel - 1442, 1446
3-05-025-02 - Aggregate Storage
3-05-025-03 - Material Transfer &
Conveying
3-05-025-04 - Hauling
3-05-025-05 - Pile Forming: Stacker
3-05-025-06 - Bulk Loading
3-05-025-07 - Storage Piles
3-05-025-08 - Dryer
3-05-025-09 - Cooler
3-05-025-10 - Crushing
3-05-025-11 - Screening

Diatomaceous Earth - 1499, 3295
3-05-026-01 - Handling
3-05-026-99 - Other Not Classified
(Specify in Comments)

Ceramic Electric Parts - 3264
3-05-030-99 - Other Not Classified
(Specify in Comments)

Asbestos Mining - 1499
3-05-031-01 - Surface Blasting
3-05-031-02 - Surface Drilling
3-05-031-03 - Cobbing
3-05-031-04 - Loading
3-05-031-05 - Convey/Haul Asbestos
3-05-031-06 - Convey/Haul Waste
3-05-031-07 - Unloading
3-05-031-08 - Overburden Stripping
3-05-031-09 - Ventilation of Process
Operations
3-05-031-10 - Stockpiling
3-05-031-11 - Tailing Piles
3-05-031-99 - Other Not Classified
(Specify in Comments)

Asbestos Milling - 1499
3-05-032-01 - Crushing
3-05-032-02 - Drying
3-05-032-03 - Recrushing
3-05-032-04 - Screening
3-05-032-05 - Fiberizing
3-05-032-06 - Bagging
3-05-032-99 - Other Not Classified
(Specify in Comments)

Vermiculite - 1499
3-05-033-01 - General

Mining and Quarrying of Nonmetallic Minerals,

except Fuels - Specify Material - 1400-1499

3-05-040-01 - Open Pit Blasting
 3-05-040-02 - Open Pit Drilling
 3-05-040-03 - Open Pit Cobbing
 3-05-040-10 - Underground Ventilation
 3-05-040-20 - Loading
 3-05-040-21 - Convey/Haul Material
 3-05-040-22 - Convey/Haul Waste
 3-05-040-23 - Unloading
 3-05-040-24 - Stripping
 3-05-040-25 - Stockpile
 3-05-040-30 - Primary Crusher
 3-05-040-31 - Secondary Crusher
 3-05-040-32 - Ore Concentrator
 3-05-040-33 - Ore Dryer
 3-05-040-34 - Screening
 3-05-040-36 - Tailing Piles
 3-05-040-99 - Other Not Classified
 (Specify in Comments)

Bulk Materials Elevators - 4463

3-05-100-01 - Unloading
 3-05-100-02 - Loading
 3-05-100-03 - Removal from Bins
 3-05-100-04 - Drying
 3-05-100-05 - Cleaning
 3-05-100-06 - Elevator Legs (Headhouse)
 3-05-100-07 - Tripper (Gallery Belt)

Bulk Materials Conveyors - 4463

3-05-101-01 - Ammonium Sulfate
 3-05-101-02 - Cement
 3-05-101-03 - Coal
 3-05-101-04 - Coke
 3-05-101-05 - Limestone
 3-05-101-06 - Phosphate Rock

Bulk Materials Conveyors - 4463

3-05-101-07 - Scrap Metal
 3-05-101-08 - Sulfur
 3-05-101-96 - Chemical: Specify in Comments
 3-05-101-97 - Fertilizer: Specify in Comments
 3-05-101-98 - Mineral: Specify in Comments
 3-05-101-99 - Other Not Classified
 (Specify in Comments)

Storage Bins - 4463

3-05-102-01 - Ammonium Sulfate
 3-05-102-02 - Cement
 3-05-102-03 - Coal
 3-05-102-04 - Coke
 3-05-102-05 - Limestone
 3-05-102-06 - Phosphate Rock
 3-05-102-07 - Scrap Metal
 3-05-102-08 - Sulfur
 3-05-102-96 - Chemical: Specify in Comments
 3-05-102-97 - Fertilizer: Specify in Comments
 3-05-102-98 - Mineral: Specify in Comments
 3-05-102-99 - Other Not Classified

Open Stockpiles - 4463

3-05-103-01 - Ammonium Sulfate
 3-05-103-02 - Cement
 3-05-103-03 - Coal
 3-05-103-04 - Coke
 3-05-103-05 - Limestone
 3-05-103-06 - Phosphate Rock
 3-05-103-07 - Scrap Metal
 3-05-103-08 - Sulfur
 3-05-103-96 - Chemical
 3-05-103-97 - Fertilizer
 3-05-103-98 - Mineral
 3-05-103-99 - Other Not Classified
 (Specify in Comments)

Unloading Operation - 4463

3-05-104-01 - Ammonium Sulfate
 3-05-104-02 - Cement
 3-05-104-03 - Coal
 3-05-104-04 - Coke
 3-05-104-05 - Limestone
 3-05-104-06 - Phosphate Rock
 3-05-104-07 - Scrap Metal
 3-05-104-08 - Sulfur
 3-05-104-96 - Chemical
 3-05-104-97 - Fertilizer
 3-05-104-98 - Mineral
 3-05-104-99 - Other Not Classified
 (Specify in Comments)

Loading Operation - 4463

3-05-105-01 - Ammonium Sulfate
 3-05-105-02 - Cement
 3-05-105-03 - Coal
 3-05-105-04 - Coke
 3-05-105-05 - Limestone
 3-05-105-06 - Phosphate Rock
 3-05-105-07 - Scrap Metal
 3-05-105-08 - Sulfur
 3-05-105-96 - Chemical
 3-05-105-97 - Fertilizer
 3-05-105-98 - Mineral
 3-05-105-99 - Other Not Classified

Mineral Products - Fugitive Emissions

3-05-888-01 - Specify in Comments Field
 3-05-888-02 - Specify in Comments Field
 3-05-888-03 - Specify in Comments Field
 3-05-888-04 - Specify in Comments Field
 3-05-888-05 - Specify in Comments Field

Mineral Products - Fuel Fired Equipment

Process Heaters

3-05-900-01 - Distillate Oil (No. 2)
 3-05-900-02 - Residual Oil
 3-05-900-03 - Natural Gas

Incinerators

3-05-900-11 - Distillate Oil (No. 2)
 3-05-900-12 - Residual Oil
 3-05-900-13 - Natural Gas

Flares

3-05-900-21 - Distillate Oil (No. 2)
 3-05-900-22 - Residual Oil
 3-05-900-23 - Natural Gas

Mineral Products: Other Not Classified

3-05-999-99

PETROLEUM INDUSTRY - MAJOR GROUP 29 hh

Process Heaters - 2911

3-06-001-03 - Oil Fired

3-06-001-04 - Gas Fired

3-06-001-05 - Natural Gas-Fired

3-06-001-06 - Process Gas-Fired

3-06-001-07 - LPG Fired

3-06-001-08 - Landfill Gas-Fired

3-06-001-99 - Other Not Classified

Fluid Catalytic Cracking Units (FCC) - 2911

3-06-002-01 - Fluid Catalytic Cracking Unit

3-06-002-02 - Catalyst Handling System

3-06-003-01 - Thermal Catalytic Cracking Unit

Blowdown Systems - 2911

3-06-004-01 - Blowdown System with Vapor Recovery System with Flaring

3-06-004-02 - Blowdown System without Controls

Fugitive Hydrocarbon Emissions From Petroleum Refining - 2911

3-06-005-03 - Process Drains and Waste Water Separators

3-06-005-04 - Process Drains and Waste Water Separators

3-06-005-05 - Waste Water Treatment Plant Excluding Separator

3-06-005-06 - Waste Water Treatment Plant Excluding Separator

Vacuum Distillation Column Condensors - 2911

3-06-006-02 - Vacuum Distillation Column Condenser

3-06-006-03 - Vacuum Distillation Column Condenser

Cooling Towers - 2911

3-06-007-01 - Cooling Towers

3-06-007-02 - Cooling Towers

Fugitive Hydrocarbon Emissions From Petroleum Refining - 2911

3-06-008-01 - Pipeline Valves and Flanges

3-06-008-02 - Vessel Relief Valves

3-06-008-03 - Pump Seals (Without Controls)

3-06-008-04 - Compressor Seals

3-06-008-05 - Miscellaneous: Sampling/Non-Asphalt Blowing, Purging, etc.

3-06-008-06 - Pump Seals (With Controls)

3-06-008-07 - Blind Changing

Pipeline Valves - 2911 jj

3-06-008-11 - Gas Streams

3-06-008-12 - Light Liquid/Gas Stream

3-06-008-13 - Heavy Liquid Stream

3-06-008-14 - Hydrogen Streams

3-06-008-15 - Open-ended Valves (All Streams)

3-06-008-16 - Flanges (All Streams)

3-06-008-17 - Pump Seals (Liquid/Gas Stream)

3-06-008-18 - Pump Seals (Heavy Liquid Stream)

3-06-008-19 - Compressor Seals (Gas Streams)

3-06-008-20 - Compressor Seals (Heavy Liquid Stream)

3-06-008-21 - Drains (All Streams)

3-06-008-22 - Vessel Relief Valves(All Streams)

Flares - 2900-2999

3-06-009-01 - Distillate Oil (No. 2)

3-06-009-02 - Residual Oil

3-06-009-03 - Natural Gas

3-06-009-04 - Process Gas

Sludge Convertor - 2999

3-06-010-01 - General

Asphalt Blowing -2911

3-06-011-01 - Asphalt Blowing

Fluid Coking Units - 2911

3-06-012-01 - Fluid Coking Units

Petroleum Coke Calcining - 2911

3-06-014-01 - Coke Calciner

Bauxite Burning

3-06-015-99 - Other Not Classified
(Specify in Comments)

Incinerators - 2900-2999

3-06-099-01 - Distillate Oil (No. 2)

3-06-099-02 - Residual Oil

3-06-099-03 - Natural Gas

3-06-099-04 - Process Gas

Lube Oil Refining - 2992

3-06-100-01 - General

Petroleum Industry - Fugitive Emissions

3-06-888-01 - Specify in Comments Field

3-06-888-02 - Specify in Comments Field

3-06-888-03 - Specify in Comments Field

3-06-888-04 - Specify in Comments Field

3-06-888-05 - Specify in Comments Field

PULP AND PAPER INDUSTRY - MAJOR GROUPS 24, 25, 26, 27

Sulfate (Kraft) Pulping - 2611, 2621, 2631

(For Bark Boilers, See Industrial Boilers)

- 3-07-001-01 - Digester Relief and Blow Tank
- 3-07-001-02 - Washers/Screens
- 3-07-001-03 - Multi-Effect Evaporator
- 3-07-001-04 - Recovery Furnace/Direct Contact Evaporator
- 3-07-001-05 - Smelt Dissolving Tank
- 3-07-001-06 - Lime Kiln
- 3-07-001-07 - Turpentine Condenser
- 3-07-001-08 - Fluid Bed Calciner
- 3-07-001-09 - Liquor Oxidation Tower
- 3-07-001-10 - Recovery Furnace/Indirect Contact Evaporator
- 3-07-001-99 - Other Not Classified
(Specify in Comments)

Sulfite Pulping - 2611, 2621, 2631

- 3-07-002-03 - Digester/Blow Pit/Dump Tank (All Bases Except Ca)
- 3-07-002-11 - Digester/Blow Pit/Dump Tank (Ca)
- 3-07-002-12 - Digester/Blow Pit/Dump Tank (MgO with Recovery System)
- 3-07-002-13 - Digester/Blow Pit/Dump Tank (MgO w/Process Change and Scrubber)
- 3-07-002-14 - Digester/Blow Pit/Dump Tank (NH₃ w/Process Change and Scrubber)
- 3-07-002-15 - Digester/Blow Pit/Dump Tank (Na w/Process Change and Scrubber)
- 3-07-002-21 - Recovery System (MgO)
- 3-07-002-22 - Recovery System (NH₃)
- 3-07-002-23 - Recovery System (Na)
- 3-07-002-31 - Acid Plant (NH₃)
- 3-07-002-32 - Acid Plant (Na)
- 3-07-002-33 - Acid Plant (Ca)
- 3-07-002-34 - Other Misc. Sources:
Knotters/Washers/
Screens, etc.

Neutral Sulfite Semichemical Pulping

- 2611, 2621, 2531 (For Bark Boilers,

See Industrial Boilers)

- 3-07-003-01 - Digester/Dump Tank/Blow Pit
- 3-07-003-02 - Evaporator
- 3-07-003-03 - Fluid Bed Reactor
- 3-07-003-04 - Sulfur Burner/Absorbers

Pulpboard Manufacture - 2631, 2661

- 3-07-004-01 - Paperboard: General
- 3-07-004-02 - Fiberboard: General

Wood Pressure Treating - 2491

- 3-07-005-01 - Creosote
- 3-07-005-97 - Other Not Classified
(Specify in Comments)
- 3-07-005-98 - Other Not Classified
(Specify in Comments)
- 3-07-005-99 - Other Not Classified
(Specify in Comments)

Plywood/Particleboard Operations

- 2435, 2436, 2492

- 3-07-007-01 - General: Not Classified
- 3-07-007-02 - Sanding Operations
- 3-07-007-03 - Particleboard Drying
- 3-07-007-04 - Waferboard Dryer
- 3-07-007-05 - Hardboard: Coe Dryer
- 3-07-007-06 - Hardboard: Predryer
- 3-07-007-07 - Hardboard: Pressing
- 3-07-007-08 - Hardboard: Tempering
- 3-07-007-09 - Hardboard: Bake Oven
- 3-07-007-11 - Fir-Sapwood-Steam Fired
- 3-07-007-12 - Fir-Sapwood-Gas Fired
- 3-07-007-13 - Fir-Heartwood
- 3-07-007-14 - Larch

3-07-007-15 - Southern Pine

- 3-07-007-98 - Other Not Classified
(Specify in Comments)
- 3-07-007-99 - Other Not Classified
(Specify in Comments)

Sawmill Operations - 2421, 2426, 2429

- 3-07-008-01 - Log Debarking
- 3-07-008-02 - Log Sawing
- 3-07-008-03 - Sawdust Pile Handling
- 3-07-008-04 - Sawing: Cyclone Exhaust
- 3-07-008-05 - Planing/Trimming: Cyclone Exhaust
- 3-07-008-06 - Sanding: Cyclone Exhaust
- 3-07-008-07 - Sanderdust: Cyclone Exhaust
- 3-07-008-08 - Other Cyclones: Exhaust
- 3-07-008-96 - Other Not Classified
(Specify in Comments)
- 3-07-008-97 - Other Not Classified
(Specify in Comments)
- 3-07-008-98 - Other Not Classified
(Specify in Comments)
- 3-07-008-99 - Other Not Classified
(Specify in Comments)

Paper Coating & Glazing - 2641, 2642, 2643, 2651,
2654, 2655, 2661

- 3-07-011-99 - Extrusion Coating Line
(Applications of solvent free resin or wax)

Miscellaneous Paper Products - 2649

- 3-07-013-01 - Shredding Newspaper for Insulation Manufacture
- 3-07-013-99 - Other Not Classified
(Specify in Comments)

Furniture Manufacturing - 2500-2599

- 3-07-020-98 - Other Not Classified
(Specify in Comments)
- 3-07-020-99 - Other Not Classified
(Specify in Comments)

Miscellaneous Woodworking Operations - 2421,

2426, 2429, 2431, 2434, 2439

- 3-07-030-01 - Wood Waste Storage Bin Vent
- 3-07-030-02 - Wood Waste Storage Bin Loadout
- 3-07-030-96 - Sanding/Planing Operations
(Specify in Comments)
- 3-07-030-97 - Sanding/Planing Operations
(Specify in Comments)
- 3-07-030-98 - Sanding/Planing Operations
(Specify in Comments)
- 3-07-030-99 - Sanding/Planing Operations
(Specify in Comments)

Wood Products - Fugitive Emissions

- 3-07-888-01 - Specify in Comments Field
- 3-07-888-02 - Specify in Comments Field
- 3-07-888-03 - Specify in Comments Field
- 3-07-888-04 - Specify in Comments Field
- 3-07-888-05 - Specify in Comments Field
- 3-07-888-98 - Specify in Comments Field

Wood Products - Fuel Fired Equipment

Process Heaters

- 3-07-900-01 - Distillate Oil (No. 2)
- 3-07-900-02 - Residual Oil
- 3-07-900-03 - Natural Gas

Incinerators

- 3-07-900-11 - Distillate Oil (No. 2)
- 3-07-900-12 - Residual Oil
- 3-07-900-13 - Natural Gas

Flares

- 3-07-900-21 - Distillate Oil (No. 2)
- 3-07-900-22 - Residual Oil
- 3-07-900-23 - Natural Gas

Wood Products: Other Not Classified

- 3-07-999-98 - Specify in Comments

RUBBER AND MISCELLANEOUS PLASTICS PRODUCTS -

MAJOR GROUP 30 & 75

Tire Manufacturing - 3011

- 3-08-001-01 - Undertread and Sidewall Cementing
- 3-08-001-02 - Bead Dipping
- 3-08-001-03 - Bead Swabbing
- 3-08-001-04 - Tire Building
- 3-08-001-05 - Tread End Cementing
- 3-08-001-06 - Green Tire Spraying
- 3-08-001-07 - Tire Curing
- 3-08-001-08 - Solvent Mixing
- 3-08-001-09 - Solvent Storage
- 3-08-001-20 - Undertread and Sidewall Cementing
- 3-08-001-21 - Tread End Cementing
- 3-08-001-22 - Bead Dipping
- 3-08-001-23 - Green Tire Spraying
- 3-08-001-97 - Other Not Classified
(Specify in Comments)
- 3-08-001-98 - Other Not Classified
(Specify in Comments)
- 3-08-001-99 - Other Not Classified
(Specify in Comments)

Tire Retreading - 7534

- 3-08-005-01 - Tire Buffing Machines

Other Fabricated Rubber Products

- 3021, 3031, 3041, 3069

- 3-08-006-99 - Other Not Classified
(Specify in Comments)

Fabricated Plastics Products - 3079

- 3-08-007-01 - Plastics Machining (Drilling,
Sanding, Sawing, etc.).
- 3-08-007-02 - Mold Release
- 3-08-007-03 - Solvent Consumption
- 3-08-007-04 - Adhesive Consumption
- 3-08-007-05 - Wax Burnout Oven

Fiberglass Resin Products

- 3-08-007-20 - General
- 3-08-007-21 - Gel Coat-Roll On
- 3-08-007-22 - Gel Coat-Spray On
- 3-08-007-23 - General-Roll On
- 3-08-007-24 - Resin-General-Spray On

Fabricated Plastics Products - 3079

- 3-08-007-99 - Other Not Classified
(Specify in Comments)

Rubber & Miscellaneous Plastics Products -

Fuel Fired Equipment

Process Heaters

- 3-08-900-01 - Distillate Oil (No. 2)
- 3-08-900-02 - Residual Oil
- 3-08-900-03 - Natural Gas

Incinerators

- 3-08-900-11 - Distillate Oil (No. 2)
- 3-08-900-12 - Residual Oil
- 3-08-900-13 - Natural Gas

Flares

- 3-08-900-21 - Distillate Oil (No. 2)
- 3-08-900-22 - Residual Oil
- 3-08-900-23 - Natural Gas

Rubber and Plastics: Other Not Classified

- 3-08-999-99 - Specify in Comments

FABRICATED METAL PRODUCTS - MAJOR GROUP 34 & 50

General Processes

- 3-09-001-98 - Other Not Classified
(Specify in Comments)
- 3-09-001-99 - Other Not Classified
(Specify in Comments)

Abrasive Blasting of Metal Parts

- 3-09-002-01 - General
- 3-09-002-02 - Sand Abrasive
- 3-09-002-03 - Slag Abrasive
- 3-09-002-04 - Garnet Abrasive
- 3-09-002-05 - Steel Grit Abrasive
- 3-09-002-06 - Walnut Shell Abrasive
- 3-09-002-07 - Shotblast w/air
- 3-09-002-08 - Shotblast w/o air
- 3-09-002-98 - General
- 3-09-002-99 - General

Abrasive Cleaning of Metal Parts

3-09-003-01 - Brush Cleaning
3-09-003-02 - Tumble Cleaning
3-09-003-03 - Polishing
3-09-003-04 - Buffing

Electroplating Operations - 3471

3-09-010-01 - General: Entire Process

3-09-010-98 - Other Not Classified
(Specify in Comments)

Conversion Coating of Metal Products - 3471

3-09-011-01 - Alkaline Cleaning Bath
3-09-011-02 - Acid Cleaning Bath (Pickling)
3-09-011-03 - Anodizing Kettle
3-09-011-04 - Rinsing/Finishing
3-09-011-99 - Other Not Classified
(Specify in Comments)

Chemical Milling of Metal Parts - 3471

3-09-015-01 - Milling Tank

Metal Pipe Coating with Asphalt/Coal Tar - 3479

3-09-016-01 - Asphalt Dipping
3-09-016-02 - Pipe Spinning
3-09-016-03 - Pipe Wrapping
3-09-016-04 - Coal Tar/Asphalt Melting Kettle

Drum Cleaning/Reclamation - 5085

3-09-025-01 - Drum Burning Furnace

Metal Deposition Processes

3-09-040-01 - Metallizing (Wire Atomization and Spraying)
3-09-040-10 - Thermal Spraying of Powdered Metal
3-09-040-20 - Plasma Arc Spraying of Powdered Metal

Porcelain Enamel and Ceramic Glaze Spraying - 3431

3-09-060-01 - Spray Booth

3-09-060-99 - Spray Booth

Fabricated Metals - Fugitive Emissions f

3-09-888-01 - Specify in Comments Field
3-09-888-02 - Specify in Comments Field
3-09-888-03 - Specify in Comments Field
3-09-888-04 - Specify in Comments Field
3-09-888-05 - Specify in Comments Field

Fabricated Metal Products - Fuel Fired Equipment

Process Heaters

3-09-900-01 - Distillate Oil (No. 2)
3-09-900-02 - Residual Oil
3-09-900-03 - Natural Gas

Incinerators

3-09-900-11 - Distillate Oil (No. 2)
3-09-900-12 - Residual Oil
3-09-900-13 - Natural Gas

Flares

3-09-900-21 - Distillate Oil (No. 2)
3-09-900-22 - Residual Oil
3-09-900-23 - Natural Gas

Fabricated Metal Products: Other Not Classified

3-09-999-97 - Other Not Classified
(Specify in Comments)
3-09-999-98 - Other Not Classified
(Specify in Comments)
3-09-999-99 - Other Not Classified
(Specify in Comments)

OIL & GAS PRODUCTION - MAJOR GROUP 13

Crude Oil Production - 1311

3-10-001-01 - Complete Well: Fugitive Emissions
3-10-001-02 - Miscellaneous Wells: General
3-10-001-03 - Wells-Rod Pumps
3-10-001-04 - Crude Oil Sumps
3-10-001-05 - Crude Oil Pits
3-10-001-99 - Processing Operations: Not Classified (Specify in Comments)

Natural Gas Production - 1311

3-10-002-01 - Gas Sweetening
(Amine Process)
(Smokeless Flares/Tail Gas Incinerators)
3-10-002-02 - Gas Stripping Operations
3-10-002-03 - Compressors
3-10-002-04 - Wells
3-10-002-05 - Flares
3-10-002-06 - Gas Lift
3-10-002-99 - Other Not Classified
(Specify in Comments)

Oil & Gas Production - Fuel Fired Equipment

Process Heaters

3-10-004-01 - Distillate Oil
3-10-004-02 - Residual Oil
3-10-004-03 - Crude Oil
3-10-004-04 - Natural Gas
3-10-004-05 - Process Gas

Steam Generators

3-10-004-11 - Distillate Oil
3-10-004-12 - Residual Oil
3-10-004-13 - Crude Oil
3-10-004-14 - Natural Gas
3-10-004-15 - Process Gas

Oil & Gas Production - Fugitive Emissions

3-10-888-01 - Specify in Comments Field
3-10-888-02 - Specify in Comments Field
3-10-888-03 - Specify in Comments Field
3-10-888-04 - Specify in Comments Field
3-10-888-05 - Specify in Comments Field

BUILDING CONSTRUCTION - MAJOR GROUP 15

Construction: Building Contractors

3-11-001-99 - Other Not Classified
(Specify in Comments)

Construction: Special Trade Contract

3-11-002-99 - Other Not Classified
(Specify in Comments)

MACHINERY, MISCELLANEOUS - MAJOR GROUP 35

Miscellaneous Machinery

3-12-999-99 - Other Not Classified
(Specify in Comments)

ELECTRICAL EQUIPMENT - MAJOR GROUP 76

Electrical Windings Reclamation - 7694

3-13-070-01 - Single Chamber Incinerator/Oven
3-13-070-02 - Multiple Chamber Incinerator/Oven

Electrical Equipment - Fuel Fired Equipment

Process Heaters

3-13-900-01 - Distillate Oil (No. 2)
3-13-900-02 - Residual Oil
3-13-900-03 - Natural Gas

Miscellaneous Electrical Equipment

3-13-999-99 - Other Not Classified
(Specify in Comments)

TRANSPORTATION EQUIPMENT - MAJOR GROUP 37, 50, 75

Automobile/Truck Assembly Operations - 3711, 3713

3-14-009-01 - Solder Joint Grinding

Brake Shoe Debonding - 7539

3-14-010-01 - Single Chamber Incinerator
3-14-010-02 - Multiple Chamber Incinerator

Auto Body Shredding - 5093

3-14-011-01 - Primary Metal Recovery Line
3-14-011-02 - Secondary Metal Recovery Line

Miscellaneous Transportation Equipment

3-14-999-99 - Other Not Classified
(Specify in Comments)

PHOTOGRAPHIC EQUIPMENT - MAJOR GROUP 38

Photocopying Equipment Manufacture - 3861

3-15-010-01 - Resin Transfer/Storage
3-15-010-02 - Toner Classification
3-15-010-03 - Toner (Carbon Black) Grinding

HEALTH SERVICES - MAJOR GROUP 80

Hospitals - 8062

3-15-020-01 - Sterilization w/Ethylene Oxide

LEATHER AND LEATHER PRODUCTS - MAJOR GROUP 31

Leather and Leather Products - 3111-3199

3-20-999-97 - Other Not Classified
(Specify in Comments)
3-20-999-98 - Other Not Classified
(Specify in Comments)
3-20-999-99 - Other Not Classified
(Specify in Comments)

TEXTILE PRODUCTS - MAJOR GROUP 22 & 30

Miscellaneous General Fabric Operations

- 2261, 2262, 2281-2284, 2291, 2294, 2297, 2299
3-30-001-01 - Yarn Preparation/Bleaching
3-30-001-02 - Printing PP
3-30-001-03 - Polyester Thread Production
3-30-001-04 - Tenter Frames: Heat Setting
3-30-001-05 - Carding
3-30-001-98 - Other Not Classified
(Specify in Comments)
3-30-001-99 - Other Not Classified
(Specify in Comments)

Rubberized Fabric - 3069, 2241

3-30-002-01 - Impregnation
3-30-002-02 - Wet Coating
3-30-002-03 - Hot Melt Coating
3-30-002-98 - Other Not Classified
(Specify in Comments)
3-30-002-99 - Other Not Classified
(Specify in Comments)

Carpet Operations - 2271, 2272, 2279

3-30-003-99 - Other Not Classified
(Specify in Comments)

Fabric Finishing - 2261, 2262, 2269

(Shrink proofing, water proofing,
anti wrinkling, sizing, etc.)

3-30-004-99 - Other Not Classified
(Specify in Comments)

3-30-005-99 - Other Not Classified
(Specify in Comments)

Textile Products - Fugitive Emissions

3-30-888-01 - Specify in Comments Field
3-30-888-02 - Specify in Comments Field
3-30-888-03 - Specify in Comments Field
3-30-888-04 - Specify in Comments Field
3-30-888-05 - Specify in Comments Field

PRINTING AND PUBLISHING - TYPESETTING - MAJOR GROUP 27

Typeetting (Lead Remelting) - 2791

3-60-001-01 - Remelting (Lead Emissions Only)

IN-PROCESS FUEL USE 99

Anthracite Coal

3-90-001-99 - General

Bituminous Coal

3-90-002-01 - Cement Kiln/Dryer

3-90-002-03 - Lime Kiln

3-90-002-99 - General

Lignite

3-90-003-99 - General

Residual Oil

3-90-004-02 - Cement Kiln/Dryer

3-90-004-03 - Lime Kiln

3-90-004-99 - General

Distillate Oil

3-90-005-02 - Cement Kiln/Dryer

3-90-005-03 - Lime Kiln

3-90-005-98 - Grade 4 Oil: General

3-90-005-99 - General

Natural Gas

3-90-006-02 - Cement Kiln/Dryer

3-90-006-03 - Lime Kiln

3-90-006-99 - General

Process Gas

3-90-007-01 - Coke Oven or Blast Furnace

3-90-007-02 - Coke Oven Gas

3-90-007-97 - General: Specify in Comments

3-90-007-98 - General: Specify in Comments

3-90-007-99 - General: Specify in Comments

Coke

3-90-008-99 - General

Wood

3-90-009-99 - General

Liquified Petroleum Gas

3-90-010-99 - General

Solid Waste

3-90-012-99 - Specify in Comments

Liquid Waste

3-90-013-99 - Specify in Comments

MISCELLANEOUS MANUFACTURING INDUSTRIES - MAJOR GROUP 39

Miscellaneous Manufacturing Industries - Fuel Fired Equipment

Process Heaters

3-99-900-01 - Distillate Oil (No. 2)

3-99-900-02 - Residual Oil

3-99-900-03 - Natural Gas

3-99-900-04 - Process Gas

Incinerators

3-99-900-11 - Distillate Oil (No. 2)

3-99-900-12 - Residual Oil

3-99-900-13 - Natural Gas

3-99-900-14 - Process Gas

Flares

3-99-900-21 - Distillate Oil (No. 2)

3-99-900-22 - Residual Oil

3-99-900-23 - Natural Gas

3-99-900-24 - Process Gas

Miscellaneous Industrial Processes

3-99-999-95 - Other Not Classified
(Specify in Comments)

3-99-999-96 - Other Not Classified
(Specify in Comments)

3-99-999-98 - Other Not Classified
(Specify in Comments)

3-99-999-99 - Other Not Classified
(Specify in Comments)

ORGANIC SOLVENT EVAPORATION - DRY CLEANING -

MAJOR GROUP 72

Dry Cleaning - 7215, 7216, 7218

4-01-001-01 - Perchloroethylene

4-01-001-02 - Stoddard (Petroleum Solvent)

4-01-001-03 - Perchloroethylene

4-01-001-04 - Stoddard (Petroleum Solvent)

4-01-001-05 - Trichlorotrifluoroethane tt
(Freon)

4-01-001-06 - Trichlorotrifluoroethane tt
(Freon)

4-01-001-98 - Other Not Classified
(Specify in Comments)

ORGANIC SOLVENT EVAPORATION - DEGREASING -

METAL CLEANING - MAJOR GROUPS 25, 33, 34, 35, 36, 37, 38, 39, 75

Open-top Vapor Degreasing

4-01-002-01 - Stoddard (Petroleum Naphtha)

4-01-002-02 - 1,1,1-Trichloroethane tt
(Methyl Chloroform)

4-01-002-03 - Perchloroethylene

4-01-002-04 - Methylene Chloride tt

4-01-002-05 - Trichloroethylene

4-01-002-06 - Toluene

4-01-002-07 - Trichlorotrifluoroethane tt

4-01-002-15 - Entire Unit uu

4-01-002-16 - Entire Unit uu

4-01-002-17 - Entire Unit uu

4-01-002-97 - Other Not Classified
(Specify in Comments)

4-01-002-99 - Other Not Classified
(Specify in Comments)

DEGREASING - METAL CLEANING - MAJOR GROUPS 25, 33,
34, 35, 36, 37, 38, 39, 75 (continued)

Conveyorized Vapor Degreasing

- 4-01-002-21 - Stoddard (Petroleum Naphtha)
- 4-01-002-22 - 1,1,1-Trichloroethane tt
- 4-01-002-23 - Perchloroethylene
- 4-01-002-24 - Methylene Chloride tt
- 4-01-002-25 - Trichloroethylene
- 4-01-002-35 - Entire Unit: w/vaporized uu solvent
- 4-01-002-36 - Entire Unit: w/nonboiling uu solvent
- 4-01-002-96 - Other Not Classified
(Specify in Comments)
- 4-01-002-98 - Other Not Classified
(Specify in Comments)

Degreasing Units - General

- 4-01-002-51 - Stoddard Solvent
- 4-01-002-52 - 1,1,1-Trichloroethane tt
- 4-01-002-53 - Perchloroethylene
- 4-01-002-54 - Methylene Chloride tt
- 4-01-002-55 - Trichloroethylene
- 4-01-002-56 - Toluene
- 4-01-002-57 - Trichlorotrifluoroethane
- 4-01-002-95 - Other Not Classified
(Specify in Comments)

Cold Solvent Cleaning/Stripping

- 4-01-003-01 - Methanol
- 4-01-003-02 - Methylene Chloride tt
- 4-01-003-03 - Stoddard (Petroleum Solvent)
- 4-01-003-04 - Perchloroethylene
- 4-01-003-05 - 1,1,1-Trichloroethane tt
(Methyl Chloroform)
- 4-01-003-06 - Trichloroethylene
- 4-01-003-35 - Entire Unit uu
- 4-01-003-36 - Entire Unit uu
- 4-01-003-98 - Other Not Classified
(Specify in Comments)
- 4-01-003-99 - Other Not Classified
(Specify in Comments)

Knit Fabric Scouring with Chlorinated Solvent -

2211-2241, 2261-2269, 2281-2284

(Removal of Finish Oils from Fabric)

- 4-01-004-01 - Perchloroethylene
- 4-01-004-99 - Other Not Classified
(Specify in Comments)

Organic Solvent Evaporation - Fugitive Emissions

- 4-01-888-01 - Specify in Comments Field
- 4-01-888-02 - Specify in Comments Field
- 4-01-888-03 - Specify in Comments Field
- 4-01-888-04 - Specify in Comments Field
- 4-01-888-05 - Specify in Comments Field
- 4-01-888-98 - Specify in Comments Field

SURFACE COATING OPERATIONS vv

Coating Application - General

- 4-02-001-01 - Paint: Solvent-base
- 4-02-001-10 - Paint: Solvent-base

- 4-02-002-01 - Paint: Water-base
- 4-02-002-10 - Paint: Water-base

- 4-02-003-01 - Varnish/Shellac
- 4-02-003-10 - Varnish/Shellac

- 4-02-004-01 - Lacquer
- 4-02-004-10 - Lacquer

- 4-02-005-01 - Enamel
- 4-02-005-10 - Enamel

- 4-02-006-01 - Primer
- 4-02-006-10 - Primer

- 4-02-007-01 - Adhesive Application
- 4-02-007-06 - Adhesive: Solvent Mixing
- 4-02-007-07 - Adhesive: Solvent Storage
- 4-02-007-10 - Adhesive

Coating Oven

- 4-02-008-01 - General
- 4-02-008-10 - General
- 4-02-008-98 - General

Thinning Solvents ss, xx

- 4-02-009-01 - General: Specify in Comments
- 4-02-009-02 - Acetone
- 4-02-009-03 - Butyl Acetate
- 4-02-009-04 - Butyl Alcohol
- 4-02-009-05 - Carbitol
- 4-02-009-06 - Cellosolve
- 4-02-009-07 - Cellosolve Acetate
- 4-02-009-08 - Dimethyl Formamide
- 4-02-009-09 - Ethyl Acetate
- 4-02-009-10 - Ethyl Alcohol
- 4-02-009-11 - Gasoline
- 4-02-009-12 - Isopropyl Alcohol
- 4-02-009-13 - Isopropyl Acetate
- 4-02-009-14 - Kerosene
- 4-02-009-15 - Lactol Spirits
- 4-02-009-16 - Methyl Acetate
- 4-02-009-17 - Methyl Alcohol
- 4-02-009-18 - MEK
- 4-02-009-19 - MIBK
- 4-02-009-20 - Mineral Spirits
- 4-02-009-21 - Naphtha
- 4-02-009-22 - Toluene
- 4-02-009-23 - Varsol
- 4-02-009-24 - Xylene
- 4-02-009-25 - Benzene
- 4-02-009-26 - Turpentine
- 4-02-009-98 - General: Specify in Comments

Coating Oven Heater vv
4-02-010-01 - Natural Gas
4-02-010-02 - Distillate Oil
4-02-010-03 - Residual Oil
4-02-010-04 - Liquified Petroleum Gas (LPG)

Fabric Coating - 2295 pp
4-02-011-01 - Coating Operation
4-02-011-03 - Coating Mixing
4-02-011-04 - Coating Storage
4-02-011-05 - Equipment Cleanup

Fabric Printing - 2261, 2262, 2269 pp
4-02-011-11 - Fabric Printing: Roller
4-02-011-12 - Fabric Printing: Roller yy
4-02-011-13 - Fabric Printing: Rotary Screen
4-02-011-14 - Fabric Printing: Rotary Screen yy
4-02-011-15 - Fabric Printing: Flat Screen
4-02-011-16 - Fabric Printing: Flat Screen yy
4-02-011-99 - Other Not Classified
(Specify in Comments)

Fabric Dyeing - 2211-2241, 2261-2269, 2281-2284 pp
4-02-012-01 - Dye Application: General
4-02-012-10 - Dye Application: General

Application of Solvent-borne Coating (Paper Coating)
4-02-013-01 - Coating Operation
4-02-013-03 - Coating Mixing
4-02-013-04 - Coating Storage
4-02-013-05 - Equipment Cleaning
4-02-013-99 - Other Not Classified
(Specify in Comments)

Surface Coating of Large Appliances - 363, 365, 343, 358
4-02-014-01 - Prime Coating Operation
4-02-014-02 - Cleaning/Pretreatment
4-02-014-03 - Coating Mixing
4-02-014-04 - Coating Storage
4-02-014-05 - Equipment Cleanup
4-02-014-06 - Topcoat Spray
4-02-014-31 - Coating Line - General

4-02-014-32 - Prime Air Spray

4-02-014-33 - Prime Electrostatic Spray

4-02-014-34 - Prime Flow Coat

4-02-014-35 - Prime Dip Coat

4-02-014-36 - Prime Electro-deposition

4-02-014-37 - Top Air Spray

4-02-014-38 - Top Electrostatic Spray

4-02-014-99 - Other/Not Classified
(Specify in Comments)

Magnet Wire Surface Coating - 3357, 3351
4-02-015-01 - Coating Application/Curing
4-02-015-02 - Cleaning/Pretreatment
4-02-015-03 - Coating Mixing
4-02-015-04 - Coating Storage
4-02-015-05 - Equipment Cleanup
4-02-015-31 - Coating Line - General
4-02-015-99 - Other Not Classified
(Specify in Comments)

Surface Coating of Automobiles and Light Trucks -
3711, 3713

4-02-016-01 - Prime Application, Electrodeposition/Dip/Spray
4-02-016-02 - Cleaning/Pretreatment
4-02-016-03 - Coating Mixing
4-02-016-04 - Coating Storage
4-02-016-05 - Equipment Cleanup
4-02-016-06 - Topcoat Operation
4-02-016-19 - Prime Surfacing Operation
4-02-016-20 - Repair Topcoat Application Area

Automobiles - 3711

4-02-016-21 - Prime Coating: Solvent-borne
4-02-016-22 - Prime Coating: Electrodeposition
4-02-016-23 - Guide Coating: Solvent-borne
4-02-016-24 - Guide Coating: Waterborne
4-02-016-25 - Topcoat: Solvent-borne
4-02-016-26 - Topcoat: Waterborne

Light Duty Trucks - 3713

4-02-016-27 - Prime Coating: Solvent-borne
4-02-016-28 - Prime Coating: Electrodeposition
4-02-016-29 - Guide Coating: Solvent-borne
4-02-016-30 - Guide Coating: Waterborne
4-02-016-31 - Topcoat: Solvent-borne
4-02-016-32 - Topcoat: Waterborne
4-02-016-99 - Other Not Classified
(Specify in Comments)

Surface Coating of Metal Cans - 3411

4-02-017-02 - Cleaning/Pretreatment
4-02-017-03 - Coating Mixing
4-02-017-04 - Coating Storage
4-02-017-05 - Equipment Cleanup
4-02-017-21 - Two Piece and Exterior Base Coating
4-02-017-22 - Interior Spray Coating
4-02-017-23 - Sheet Basecoating (Interior)
4-02-017-24 - Sheet Basecoating (Exterior)
4-02-017-25 - Side Seam Spray Coating
4-02-017-26 - End Sealing Compound
4-02-017-27 - Lithography
4-02-017-28 - Over Varnish
4-02-017-31 - Three-piece Can Sheet
Basecoating
4-02-017-32 - Three-piece Can Sheet Litho-
graphic Coating Line
4-02-017-33 - Three-piece Beverage Can -
Side Seam Spray Coating
4-02-017-34 - Three-piece Beverage Can -
Interior Body Spray Coating
4-02-017-35 - Two-piece Can Coating Line
4-02-017-36 - Two-piece Can End Sealing Compound
4-02-017-99 - Other Not Classified
(Specify in Comments)

Surface Coating of Metal Coils - 3353, 3354

4-02-018-01 - Prime Coating Application
4-02-018-03 - Solvent Mixing
4-02-018-04 - Solvent Storage
4-02-018-05 - Equipment Cleanup
4-02-018-06 - Finish Coating Application
4-02-018-99 - Other Not Classified
(Specify in Comments)

Wood Furniture Surface Coating - 2511, 2512, 2517, 2521

4-02-019-01 - Coating Operation
4-02-019-03 - Coating Mixing
4-02-019-04 - Coating Storage
4-02-019-99 - Other Not Classified
(Specify in Comments)

Metal Furniture Surface Coating - 2514, 2522

4-02-020-01 - Coating Operation
4-02-020-02 - Cleaning/Pretreatment
4-02-020-03 - Coating Mixing
4-02-020-04 - Coating Storage
4-02-020-05 - Equipment Cleanup
4-02-020-31 - Single Sprayline: General
4-02-020-32 - Single Dip Line: General
4-02-020-33 - Spray High Solids Coating
4-02-020-34 - Spray Water-Borne Coating
4-02-020-99 - Other Not Classified
(Specify in Comments)

Surface Coating of Flat Wood Products - 2435, 2492, 2499

4-02-021-01 - Base Coat
4-02-021-03 - Coating Mix
4-02-021-04 - Coating Storage
4-02-021-05 - Equipment Cleanup
4-02-021-06 - Topcoat
4-02-021-07 - Filler
4-02-021-08 - Sealer
4-02-021-09 - Inks
4-02-021-31 - Waterborne Coating
4-02-021-32 - Solvent-borne Coating
4-02-021-33 - Ultraviolet Coating
4-02-021-99 - Other Not Classified
(Specify in Comments)

Surface Coating of Plastics Parts - 3079

4-02-022-01 - Coating Operation
4-02-022-02 - Cleaning/Pretreatment
4-02-022-03 - Coating Mixing
4-02-022-04 - Coating Storage
4-02-022-05 - Equipment Cleanup
4-02-022-99 - Other Not Classified
(Specify in Comments)

Surface Coating of Large Ships - 3731

4-02-023-01 - Prime Coating Operation
4-02-023-02 - Cleaning/Pretreatment
4-02-023-03 - Coating Mixing
4-02-023-04 - Coating Storage
4-02-023-05 - Equipment Cleanup
4-02-023-06 - Topcoat Operation
4-02-023-99 - Other Not Classified
(Specify in Comments)

Surface Coating of Large Aircraft - 3721

4-02-024-01 - Prime Coating Operation
4-02-024-02 - Cleaning/Pretreatment
4-02-024-03 - Coating Mixing
4-02-024-04 - Coating Storage
4-02-024-05 - Equipment Cleanup
4-02-024-06 - Topcoat Operation
4-02-024-99 - Other Not Classified
(Specify in Comments)

Surface Coating of Miscellaneous Metal Parts

4-02-025-01 - Coating Operation
4-02-025-02 - Cleaning/Pretreatment
4-02-025-03 - Coating Mixing
4-02-025-04 - Coating Storage
4-02-025-05 - Equipment Cleanup
4-02-025-31 - Conveyor Single Flow
4-02-025-32 - Conveyor Single Dip
4-02-025-33 - Conveyor Single Spray
4-02-025-34 - Conveyor Two Coat Flow and Spray
4-02-025-35 - Conveyor Two Coat, Dip and Spray
4-02-025-36 - Conveyor Two Coat, Spray
4-02-025-37 - Manual Two Coat, Spray and Air Dry
4-02-025-99 - Other Not Classified
(Specify in Comments)

Surface Coating of Steel Drums - 3412

4-02-026-01 - Coating Operation
4-02-026-02 - Cleaning/Pretreatment
4-02-026-03 - Coating Mixing
4-02-026-04 - Coating Storage
4-02-026-05 - Equipment Cleanup
4-02-026-06 - Interior Coating
4-02-026-07 - Exterior Coating
4-02-026-99 - Other Not Classified
(Specify in Comments)

Organic Solvent Evaporation - Surface Coating

Fugitive Emissions

4-02-888-01 - Specify in Comments Field
4-02-888-02 - Specify in Comments Field
4-02-888-03 - Specify in Comments Field
4-02-888-04 - Specify in Comments Field
4-02-888-05 - Specify in Comments Field

Organic Solvent Evaporation - Surface Coating -

Fuel Fired Equipment

Flares

4-02-900-21 - Distillate Oil (No. 2)
4-02-900-22 - Residual Oil
4-02-900-23 - Natural Gas

Organic Solvent Evaporation -

Surface Coating - Miscellaneous

4-02-999-97 - Specify in Comments Field
4-02-999-98 - Specify in Comments Field

PETROLEUM PRODUCT STORAGE (Refineries Oil and Gas Fields Only) - 2911, 2992, 1311, 1321

Fixed Roof Tanks (67,000 BBL. Tank Size)

- 4-03-010-01 - Gasoline RVPT3: Breathing Loss
- 4-03-010-02 - Gasoline RVP10: Breathing Loss
- 4-03-010-03 - Gasoline RVP 7: Breathing Loss
- 4-03-010-10 - Crude Oil RVP5: Breathing Loss
- 4-03-010-13 - Jet Naphtha (JP-4): Breathing
- 4-03-010-16 - Jet Kerosene: Breathing Loss
- 4-03-010-19 - Distillate Fuel #2: Breathing Loss
- 4-03-010-97 - Specify Liquid: Breathing Loss

Fixed Roof Tanks (250,000 BBL. Tank Size)

- 4-03-010-04 - Gasoline RVPT3: Breathing Loss
- 4-03-010-05 - Gasoline RVP10: Breathing Loss
- 4-03-010-06 - Gasoline RVP 7: Breathing Loss
- 4-03-010-11 - Crude Oil RVP5: Breathing Loss
- 4-03-010-14 - Jet Naphtha (JP-4): Breathing Loss
- 4-03-010-17 - Jet Kerosene: Breathing Loss
- 4-03-010-20 - Distillate Fuel #2: Breathing Loss
- 4-03-010-98 - Specify Liquid: Breathing Loss

Fixed Roof Tanks (Independent of Tank Diameter)

- 4-03-010-07 - Gasoline RVPT3: Working Loss
- 4-03-010-08 - Gasoline RVP10: Working Loss
- 4-03-010-09 - Gasoline RVP 7: Working Loss
- 4-03-010-12 - Crude Oil RVP5: Working Loss
- 4-03-010-15 - Jet Naphtha (JP-4): Working Loss
- 4-03-010-18 - Jet Kerosene: Working Loss
- 4-03-010-21 - Distillate Fuel #2: Working Loss
- 4-03-010-99 - Specify Liquid: Working Loss

Floating Roof Tanks (67,000 BBL. Tank Size)

- 4-03-011-01 - Gasoline RVPT3: Standing Loss
- 4-03-011-02 - Gasoline RVP10: Standing Loss
- 4-03-011-03 - Gasoline RVP 7: Standing Loss
- 4-03-011-09 - Crude Oil RVP5: Standing Loss
- 4-03-011-11 - Jet Naphtha (JP-4): Standing Loss
- 4-03-011-13 - Jet Kerosene: Standing Loss
- 4-03-011-15 - Distillate Fuel #2: Standing Loss
- 4-03-011-98 - Specify Liquid: Standing Loss

Floating Roof Tanks (250,000 BBL. Tank Size)

- 4-03-011-04 - Gasoline RVPT3: Standing Loss
- 4-03-011-05 - Gasoline RVP10: Standing Loss
- 4-03-011-06 - Gasoline RVP 7: Standing Loss
- 4-03-011-10 - Crude Oil RVP5: Standing Loss
- 4-03-011-12 - Jet Naphtha (JP-4): Standing Loss
- 4-03-011-14 - Jet Kerosene: Standing Loss
- 4-03-011-16 - Distillate Fuel #2: Standing Loss
- 4-03-011-99 - Specify Liquid: Standing Loss

Floating Roof Tanks (Withdrawal Loss)

- 4-03-011-07 - Gasoline RVPT3/RVP10/RVP7
- 4-03-011-08 - Gasoline RVPT3/RVP10/RVP7
- 4-03-011-17 - Crude Oil
- 4-03-011-18 - Jet Naphtha (JP-4)
- 4-03-011-19 - Jet Kerosene
- 4-03-011-20 - Distillate Fuel #2
- 4-03-011-97 - Specify Liquid

Tanks with External Floating Roof - Primary Seal

- 4-03-011-30 - Specify Liquid: Standing Loss
- 4-03-011-31 - Gasoline: Standing Loss
- 4-03-011-32 - Crude Oil: Standing Loss
- 4-03-011-33 - Jet Naphtha (JP-4): Standing Loss
- 4-03-011-34 - Jet Kerosene: Standing Loss
- 4-03-011-35 - Distillate Fuel #2: Standing Loss

Tanks with External Floating Roof - Secondary Seal

- 4-03-011-40 - Specify Liquid: Standing Loss
- 4-03-011-41 - Gasoline: Standing Loss
- 4-03-011-42 - Crude Oil: Standing Loss
- 4-03-011-43 - Jet Naphtha (JP-4): Standing Loss
- 4-03-011-44 - Jet Kerosene: Standing Loss
- 4-03-011-45 - Distillate Fuel #2: Standing Loss

Tanks with Internal Floating Roofs

- 4-03-011-50 - Specify Liquid: Standing Loss
- 4-03-011-51 - Gasoline: Standing Loss
- 4-03-011-52 - Crude Oil: Standing Loss
- 4-03-011-53 - Jet Naphtha (JP-4): Standing Loss
- 4-03-011-54 - Jet Kerosene: Standing Loss
- 4-03-011-55 - Distillate Fuel #2: Standing Loss

Variable Vapor Space Tanks - (10,500 BBL. Tank Size)

- 4-03-012-01 - Gasoline RVPT3: Filling Loss
- 4-03-012-02 - Gasoline RVP10: Filling Loss
- 4-03-012-03 - Gasoline RVP 7: Filling Loss
- 4-03-012-04 - Jet Naphtha (JP-4): Filling Loss
- 4-03-012-05 - Jet Kerosene: Filling Loss
- 4-03-012-06 - Distillate Fuel #2: Filling Loss
- 4-03-012-07 - Benzene: Filling Loss
- 4-03-012-99 - Specify Liquid: Filling Loss

Petroleum Storage Tanks - Fugitive Emissions

- 4-03-888-01 - Specify in Comments Field
- 4-03-888-02 - Specify in Comments Field
- 4-03-888-03 - Specify in Comments Field
- 4-03-888-04 - Specify in Comments Field
- 4-03-888-05 - Specify in Comments Field

BULK TERMINALS - PETROLEUM STORAGE TANKS -

MAJOR GROUP 51 & 42

Fixed Roof Tanks (67,000 BBL. Tank Size) - 5171, 4226

- 4-04-001-01 - Gasoline RVPT3: Breathing Loss
- 4-04-001-02 - Gasoline RVP10: Breathing Loss
- 4-04-001-03 - Gasoline RVP 7: Breathing Loss

Fixed Roof Tanks (67,000 BBL. Tank Size) - 5171, 4226

- 4-04-001-04 - Gasoline RVPT3: Breathing Loss
- 4-04-001-05 - Gasoline RVP10: Breathing Loss
- 4-04-001-06 - Gasoline RVP 7: Breathing Loss

Fixed Roof Tanks (Independent of Tank Diameter) -

5171, 4226

- 4-04-001-07 - Gasoline RVPT3: Working Loss
- 4-04-001-08 - Gasoline RVP10: Working Loss
- 4-04-001-09 - Gasoline RVP 7: Working Loss

Floating Roof Tanks (67,000 BBL. Tank Size) - 5171, 4226

4-04-001-10 - Gasoline RVP13: Standing Loss
4-04-001-11 - Gasoline RVP10: Standing Loss
4-04-001-12 - Gasoline RVP 7: Standing Loss
4-04-001-16 - Gasoline RVP13/10/7: Withdrawal Loss

Floating Roof Tanks (250,000 BBL. Tank Size) - 5171, 4226

4-04-001-13 - Gasoline RVP13: Standing Loss
4-04-001-14 - Gasoline RVP10: Standing Loss
4-04-001-15 - Gasoline RVP 7: Standing Loss
4-04-001-17 - Gasoline RVP13/10/7: Withdrawal Loss

Variable Vapor Space - (10,500 BBL. Tank Size) - 5171, 4226

4-04-001-18 - Gasoline RVP13: Filling Loss
4-04-001-19 - Gasoline RVP10: Filling Loss
4-04-001-20 - Gasoline RVP 7: Filling Loss

Miscellaneous Losses/Leaks - 5171, 4226

4-04-001-51 - Valves, Flanges & Pumps
4-04-001-52 - Vapor Collection Losses
4-04-001-53 - Vapor Control Unit Losses
4-04-001-54 - Tank Truck Vapor Leaks

BULK PLANTS - PETROLEUM STORAGE TANKS - MAJOR GROUPS

13, 42, 51

Fixed Roof Tanks (67,000 BBL. Tank Size) - 5171, 4226

4-04-002-01 - Gasoline RVP13: Breathing Loss
4-04-002-02 - Gasoline RVP10: Breathing Loss
4-04-002-03 - Gasoline RVP 7: Breathing Loss

Fixed Roof Tanks (67,000 BBL. Tank Size) - 5171, 4226

4-04-002-04 - Gasoline RVP13: Working Loss
4-04-002-05 - Gasoline RVP10: Working Loss
4-04-002-06 - Gasoline RVP 7: Working Loss

Floating Roof Tanks (67,000 BBL. Tank Size) - 5171, 4226

4-04-002-07 - Gasoline RVP13: Standing Loss
4-04-002-08 - Gasoline RVP10: Standing Loss
4-04-002-09 - Gasoline RVP 7: Standing Loss
4-04-002-10 - Gasoline RVP13/10/7: Withdrawal Loss

Variable Vapor Space Tanks - (10,500 BBL. Tank) -

5171, 4226
4-04-002-11 - Gasoline RVP13: Filling Loss
4-04-002-12 - Gasoline RVP10: Filling Loss
4-04-002-13 - Gasoline RVP 7: Filling Loss

Miscellaneous Losses/Leaks - 5171, 4226

4-04-002-50 - Loading Racks
4-04-002-51 - Valves, Flanges & Pumps
4-04-002-54 - Tank Truck Vapor Losses

Oil Field Storage of Crude Oil - 1311

4-04-003-01 - Fixed Roof Tank: Breathing Loss
4-04-003-02 - Fixed Roof Tank: Working Loss
4-04-003-03 - External Floating Roof Tank with Primary Seals: Standing Loss
4-04-003-04 - External Floating Roof Tank with Secondary Seals: Standing Loss
4-04-003-05 - Internal Floating Roof Tank: Standing Loss

Petroleum Product Storage - Underground Tanks -
5171, 4226

4-04-004-01 - Gasoline RVP 13: Breathing Loss
4-04-004-02 - Gasoline RVP 13: Working Loss
4-04-004-03 - Gasoline RVP 10: Breathing Loss
4-04-004-04 - Gasoline RVP 10: Working Loss
4-04-004-05 - Gasoline RVP 7: Breathing Loss
4-04-004-06 - Gasoline RVP 7: Working Loss
4-04-004-07 - Crude Oil RVP 5: Breathing Loss
4-04-004-08 - Crude Oil RVP 5: Working Loss
4-04-004-09 - Jet Naphtha JP-4: Breathing Loss
4-04-004-10 - Jet Naphtha JP-4: Working Loss
4-04-004-11 - Jet Kerosene: Breathing Loss
4-04-004-12 - Jet Kerosene: Working Loss
4-04-004-13 - Distillate Fuel # 2: Breathing Loss
4-04-004-14 - Distillate Fuel # 2: Working Loss
4-04-004-97 - Specify Liquid: Breathing Loss
4-04-004-98 - Specify Liquid: Working Loss

PRINTING/PUBLISHING - PRINTING PROCESS -
MAJOR GROUP 27

Dryers - 2711 thru 2782

4-05-001-01 - Dryer
4-05-001-99 - Dryer

Printing - 2751, 2752, 2754

4-05-002-01 - Letter Press - 2751
4-05-002-11 - Letter Press - 2751
4-05-002-12 - Letter Press - 2751

4-05-003-01 - Flexographic - 2751
4-05-003-11 - Flexographic - 2751
4-05-003-12 - Flexographic - 2751

4-05-004-01 - Lithographic - 2752
4-05-004-11 - Lithographic - 2752
4-05-004-12 - Lithographic - 2752

4-05-005-01 - Gravure - 2754
4-05-005-11 - Gravure - 2754
4-05-005-12 - Gravure - 2754
4-05-005-13 - Gravure: Publication Printing - 2754

4-05-006-01 - Ink Mixing: General

4-05-007-01 - Solvent Storage: General

Ink Thinning Solvents - 2700-2799 eee

4-05-003-02 - Carbitol
4-05-003-03 - Celllosolve
4-05-005-02 - Dimethylformamide
4-05-005-03 - Ethyl Acetate
4-05-003-04 - Ethyl Alcohol
4-05-003-05 - Isopropyl Alcohol
4-05-002-02 - Kerosene
4-05-005-06 - Methyl Ethyl Ketone
4-05-005-07 - Methyl Isobutyl Ketone
4-05-002-03 - Mineral Spirits
4-05-003-07 - Naphtha
4-05-003-06 - N-Propyl Alcohol
4-05-005-10 - Toluene
4-05-005-98 - Other Not Classified
(Specify in Comments)
4-05-005-99 - Other Not Classified
(Specify in Comments)

Printing/Publishing - Fugitive Emissions

4-05-888-01 - Specify in Comments Field
4-05-888-02 - Specify in Comments Field
4-05-888-03 - Specify in Comments Field
4-05-888-04 - Specify in Comments Field
4-05-888-05 - Specify in Comments Field

TRANSPORTATION AND MARKETING OF PETROLEUM PRODUCTS -

Tank Cars and Trucks - Normal Service -

5161, 5171, 5172, 4582

MAJOR GROUPS 44, 45, 51

4-06-001-31 - Gasoline-Submerged Loading
4-06-001-32 - Crude Oil-Submerged Loading
4-06-001-33 - Jet Naphtha (JP-4)-Submerged Loading
4-06-001-34 - Jet Kerosene-Submerged Loading
4-06-001-35 - Distillate Oil # 2-Submerged Loading
4-06-001-36 - Gasoline-Splash Loading
4-06-001-37 - Crude Oil-Splash Loading
4-06-001-38 - Jet Naphtha-Splash Loading
4-06-001-39 - Jet Kerosene-Splash Loading
4-06-001-40 - Distillate Oil # 2-Splash Loading

Tank Cars and Trucks - Balance Service -

5161, 5171, 5172, 4582

4-06-001-41 - Gasoline-Submerged Loading
4-06-001-42 - Crude Oil-Submerged Loading
4-06-001-43 - Jet Naphtha-Submerged Loading
4-06-001-44 - Gasoline-Splash Loading
4-06-001-45 - Crude Oil-Splash Loading
4-06-001-46 - Jet Naphtha-Splash Loading

Tank Cars and Trucks - Clean Tanks

- 5161, 5171, 5172, 4582
4-06-001-47 - Gasoline-Submerged Loading
4-06-001-48 - Crude oil-Submerged Loading
4-06-001-49 - Jet Naphtha (JP-4)-Submerged Loading
4-06-001-60 - Jet Kerosene-Submerged Loading
4-06-001-61 - Distillate Oil # 2-Submerged Loading

Tank Cars and Trucks - Transmit Losses -

5161, 5171, 5172, 4582

4-06-001-62 - Gasoline-Loaded with Fuel
4-06-001-63 - Gasoline-Return with Vapor

Marine Vessels - 4463

4-06-002-31 - Gasoline-Ship Loading-Cleaned
... and Vapor-free Tank
4-06-002-32 - Gasoline-Ocean Barges Loading
4-06-002-33 - Gasoline-Barges Loading-Cleaned
and Vapor-free Tank
4-06-002-34 - Gasoline-Ship Loading-Ballasted
Tank
4-06-002-35 - Gasoline-Ocean Barges Loading-
Ballasted Tank
4-06-002-36 - Gasoline-Ship Loading-Uncleaned
Tank
4-06-002-37 - Gasoline-Ocean Barges Loading-
Uncleaned Tank
4-06-002-38 - Gasoline-Barges Loading-Uncleaned
Tank
4-06-002-39 - Gasoline-Tanker-Ballasting
Tank Condition
4-06-002-40 - Gasoline-Barges Loading-Average
Tank Condition
4-06-002-41 - Gasoline-Tanker-Ballasting
4-06-002-42 - Gasoline-Transit
4-06-002-43 - Crude Oil-Loading Tankers
4-06-002-44 - Jet Fuel-Loading Tankers
4-06-002-45 - Kerosene-Loading Tankers
4-06-002-46 - Distillate Oil No. 2 Loading
4-06-002-48 - Crude Oil-Loading Barges
4-06-002-49 - Jet Fuel-Loading Barges
4-06-002-50 - Kerosene-Loading Barges
4-06-002-51 - Distillate Oil No. 2-Loading
Tankers
4-06-002-53 - Crude Oil-Tanker Ballasting
4-06-002-54 - Crude Oil-Transit-Loss
4-06-002-55 - Jet Fuel-Transit-Loss
4-06-002-56 - Kerosene-Transit-Loss
4-06-002-57 - Distillate Oil No. 2-Transit-Loss
4-06-002-59 - Tanker/Barge Cleaning

Gasoline Retail Operations - 5541

4-06-003-01 - SpLash Filling
4-06-003-02 - Submerged Filling w/o Control
4-06-003-06 - Balanced Submerged Filling
4-06-003-07 - Underground Tank Breathing

Filling Vehicle Gas Tanks - 5541

4-06-004-01 - Vapor Loss: w/o Controls
4-06-004-02 - Liquid Spill Loss: w/o Controls
4-06-004-03 - Vapor Loss: w/o Controls

Petroleum Marketing - Fugitive Emissions

4-06-888-01 - Specify in Comments Field
4-06-888-02 - Specify in Comments Field
4-06-888-03 - Specify in Comments Field
4-06-888-04 - Specify in Comments Field
4-06-888-05 - Specify in Comments Field

ORGANIC CHEMICAL STORAGE - FIXED ROOF TANKS -

MAJOR GROUPS 28, 29, 30, 51

Acid Anhydrides

- 4-07-004-01 - Acetic Anhydride: Breathing Loss
- 4-07-004-02 - Acetic Anhydride: Working Loss
- 4-07-004-97 - Specify Liquid: Breathing Loss
- 4-07-004-98 - Specify Liquid: Working Loss

Alcohols

- 4-07-008-01 - N-Butyl Alcohol: Breathing Loss
- 4-07-008-02 - N-Butyl Alcohol: Working Loss
- 4-07-008-03 - Sec-Butyl Alcohol: Breathing Loss
- 4-07-008-04 - Sec-Butyl Alcohol: Working Loss
- 4-07-008-05 - Tert-Butyl Alcohol: Breathing Loss
- 4-07-008-06 - Tert-Butyl Alcohol: Working Loss
- 4-07-008-07 - Cyclohexanol: Breathing Loss
- 4-07-008-08 - Cyclohexanol: Working Loss
- 4-07-008-09 - Ethyl Alcohol: Breathing Loss
- 4-07-008-10 - Ethyl Alcohol: Working Loss
- 4-07-008-11 - Isobutyl Alcohol: Breathing Loss
- 4-07-008-12 - Isobutyl Alcohol: Working Loss
- 4-07-008-13 - Isopropyl Alcohol: Breathing Loss
- 4-07-008-14 - Isopropyl Alcohol: Working Loss
- 4-07-008-15 - Methyl Alcohol: Breathing Loss
- 4-07-008-16 - Methyl Alcohol: Working Loss
- 4-07-008-17 - N-Propyl Alcohol: Breathing Loss
- 4-07-008-18 - N-Propyl Alcohol: Working Loss
- 4-07-008-97 - Specify Alcohol: Breathing Loss
- 4-07-008-98 - Specify Alcohol: Working Loss

Alkanes (Paraffins)

- 4-07-016-01 - N-Decane: Breathing Loss
- 4-07-016-02 - N-Decane: Working Loss
- 4-07-016-03 - N-Dodecane: Breathing Loss
- 4-07-016-04 - N-Dodecane: Working Loss
- 4-07-016-05 - N-Heptane: Breathing Loss
- 4-07-016-06 - N-Heptane: Working Loss
- 4-07-016-07 - Isopentane: Breathing Loss
- 4-07-016-08 - Isopentane: Working Loss
- 4-07-016-09 - Pentadecane: Breathing Loss
- 4-07-016-10 - Pentadecane: Working Loss
- 4-07-016-11 - Naphtha: Breathing Loss
- 4-07-016-12 - Naphtha: Working Loss
- 4-07-016-13 - Petroleum Distillate: Breathing Loss
- 4-07-016-14 - Petroleum Distillate: Working Loss
- 4-07-016-97 - Specify Alkane: Breathing Loss
- 4-07-016-98 - Specify Alkane: Working Loss

Alkenes (Olefins)

- 4-07-020-01 - Dodecene: Breathing Loss
- 4-07-020-02 - Dodecene: Working Loss
- 4-07-020-03 - Heptenes-General: Breathing Loss
- 4-07-020-04 - Heptenes-General: Working Loss
- 4-07-020-97 - Specify Alkene: Breathing Loss
- 4-07-020-98 - Specify Alkene: Working Loss

Amines

- 4-07-032-01 - Aniline: Breathing Loss
- 4-07-032-02 - Aniline: Working Loss
- 4-07-032-03 - Ethanolamines: Breathing Loss
- 4-07-032-04 - Ethanolamines: Working Loss
- 4-07-032-05 - Ethyleneamines: Breathing Loss
- 4-07-032-06 - Ethyleneamines: Working Loss
- 4-07-032-97 - Specify Amine: Breathing Loss
- 4-07-032-98 - Specify Amine: Working Loss

Aromatics

- 4-07-036-01 - Benzene: Breathing Loss
- 4-07-036-02 - Benzene: Working Loss
- 4-07-036-03 - Cresol: Breathing Loss
- 4-07-036-04 - Cresol: Working Loss
- 4-07-036-05 - Cumene: Breathing Loss
- 4-07-036-06 - Cumene: Working Loss
- 4-07-036-07 - Diisopropyl Benzene: Breathing Loss
- 4-07-036-08 - Diisopropyl Benzene: Working Loss
- 4-07-036-09 - Ethyl Benzene: Breathing Loss
- 4-07-036-10 - Ethyl Benzene: Working Loss
- 4-07-036-11 - Methylstyrene: Breathing Loss
- 4-07-036-12 - Methylstyrene: Working Loss
- 4-07-036-13 - Styrene: Breathing Loss
- 4-07-036-14 - Styrene: Working Loss
- 4-07-036-15 - Toluene: Breathing Loss
- 4-07-036-16 - Toluene: Working Loss
- 4-07-036-17 - m-Xylene: Breathing Loss
- 4-07-036-18 - m-Xylene: Working Loss
- 4-07-036-19 - o-Xylene: Breathing Loss
- 4-07-036-20 - o-Xylene: Working Loss
- 4-07-036-21 - p-Xylene: Breathing Loss
- 4-07-036-22 - p-Xylene: Working Loss
- 4-07-036-23 - Xylenes-mixed: Breathing Loss
- 4-07-036-24 - Xylenes-mixed: Working Loss
- 4-07-036-97 - Specify Aromatic: Breathing Loss
- 4-07-036-98 - Specify Aromatic: Working Loss

Carboxylic Acids

- 4-07-040-01 - Acetic Acid: Breathing Loss
- 4-07-040-02 - Acetic Acid: Working Loss
- 4-07-040-03 - Acrylic Acid: Breathing Loss
- 4-07-040-04 - Acrylic Acid: Working Loss
- 4-07-040-05 - Adipic Acid: Breathing Loss
- 4-07-040-06 - Adipic Acid: Working Loss
- 4-07-040-07 - Formic Acid: Breathing Loss
- 4-07-040-08 - Formic Acid: Working Loss
- 4-07-040-09 - Propionic Acid: Breathing Loss
- 4-07-040-10 - Propionic Acid: Working Loss
- 4-07-040-97 - Specify Acid: Breathing Loss
- 4-07-040-98 - Specify Acid: Working Loss

Esters

- 4-07-044-01 - Butyl Acetate: Breathing Loss
- 4-07-044-02 - Butyl Acetate: Working Loss
- 4-07-044-03 - Butyl Acrylate: Breathing Loss
- 4-07-044-04 - Butyl Acrylate: Working Loss
- 4-07-044-05 - Ethyl Acetate: Breathing Loss
- 4-07-044-06 - Ethyl Acetate: Working Loss
- 4-07-044-07 - Ethyl Acrylate: Breathing Loss
- 4-07-044-08 - Ethyl Acrylate: Working Loss
- 4-07-044-09 - Isobutyl Acrylate: Breathing Loss
- 4-07-044-10 - Isobutyl Acrylate: Working Loss
- 4-07-044-11 - Isopropyl Acetate: Breathing Loss
- 4-07-044-12 - Isopropyl Acetate: Working Loss
- 4-07-044-13 - Methyl Acetate: Breathing Loss
- 4-07-044-14 - Methyl Acetate: Working Loss
- 4-07-044-15 - Methyl Acrylate: Breathing Loss
- 4-07-044-16 - Methyl Acrylate: Working Loss
- 4-07-044-17 - Methyl Methacrylate: Breathing Loss
- 4-07-044-18 - Methyl Methacrylate: Working Loss
- 4-07-044-19 - Vinyl Acetate: Breathing Loss
- 4-07-044-20 - Vinyl Acetate: Working Loss
- 4-07-044-97 - Specify Ester: Breathing Loss
- 4-07-044-98 - Specify Ester: Working Loss

ORGANIC CHEMICAL STORAGE - FIXED ROOF TANKS -

MAJOR GROUPS 28, 29, 30, 51

Ethers

- 4-07-048-01 - Methyl-tert-Butyl Ether: Breathing Loss
4-07-048-02 - Methyl-tert-Butyl Ether: Working Loss
4-07-048-97 - Specify Ether: Breathing Loss
4-07-048-98 - Specify Ether: Working Loss

Glycol Ethers fff

- 4-07-052-01 - Butyl Carbitol: Breathing Loss
4-07-052-02 - Butyl Carbitol: Working Loss
4-07-052-03 - Butyl Cellosolve: Breathing Loss
4-07-052-04 - Butyl Cellosolve: Working Loss
4-07-052-05 - Carbitol: Breathing Loss
4-07-052-06 - Carbitol: Working Loss
4-07-052-07 - Cellosolve: Breathing Loss
4-07-052-08 - Cellosolve: Working Loss
4-07-052-09 - Diethylene Glycol: Breathing Loss
4-07-052-10 - Diethylene Glycol: Working Loss
4-07-052-11 - Methyl Carbitol: Breathing Loss
4-07-052-12 - Methyl Carbitol: Working Loss
4-07-052-13 - Methyl Cellosolve: Breathing Loss
4-07-052-14 - Methyl Cellosolve: Working Loss
4-07-052-15 - Polyethylene Glycol: Breathing Loss
4-07-052-16 - Polyethylene Glycol: Working Loss
4-07-052-17 - Triethylene Glycol: Breathing Loss
4-07-052-18 - Triethylene Glycol: Working Loss
4-07-052-97 - Specify Glycol Ether: Breathing Loss
4-07-052-98 - Specify Glycol Ether: Working Loss

Glycols

- 4-07-056-01 - 1,4-Butanediol: Breathing Loss
4-07-056-02 - 1,4-Butanediol: Working Loss
4-07-056-03 - Ethylene Glycol: Breathing Loss
4-07-056-04 - Ethylene Glycol: Working Loss
4-07-056-05 - Dipropylene Glycol: Breathing Loss
4-07-056-06 - Dipropylene Glycol: Working Loss
4-07-056-07 - Glycerol: Breathing Loss
4-07-056-08 - Glycerol: Working Loss
4-07-056-09 - Propylene Glycol: Breathing Loss
4-07-056-10 - Propylene Glycol: Working Loss
4-07-056-97 - Specify Glycol: Breathing Loss
4-07-056-98 - Specify Glycol: Working Loss

Halogenated Organics

- 4-07-060-01 - Benzyl Chloride: Breathing Loss
4-07-060-02 - Benzyl Chloride: Working Loss
4-07-060-03 - Caprolactum: Breathing Loss
4-07-060-04 - Caprolactum: Working Loss
4-07-060-05 - Carbon Tetrachloride: Breathing Loss
4-07-060-06 - Carbon Tetrachloride: Working Loss
4-07-060-07 - Chlorobenzene: Breathing Loss
4-07-060-08 - Chlorobenzene: Working Loss
4-07-060-09 - o-Dichlorobenzene: Breathing Loss
4-07-060-10 - o-Dichlorobenzene: Working Loss
4-07-060-11 - p-Dichlorobenzene: Breathing Loss
4-07-060-12 - p-Dichlorobenzene: Working Loss
4-07-060-13 - Epichlorohydrin: Breathing Loss
4-07-060-14 - Epichlorohydrin: Working Loss
4-07-060-15 - Ethylene Dibromide: Breathing Loss
4-07-060-16 - Ethylene Dibromide: Working Loss
4-07-060-17 - Ethylene Dichloride: Breathing Loss
4-07-060-18 - Ethylene Dichloride: Working Loss
4-07-060-19 - Methylene Chloride: Breathing Loss

Halogenated Organics (continued)

- 4-07-060-20 - Methylene Chloride: Working Loss
4-07-060-21 - Perchloroethylene: Breathing Loss
4-07-060-22 - Perchloroethylene: Working Loss
4-07-060-23 - Trichloroethylene: Breathing Loss
4-07-060-24 - Trichloroethylene: Working Loss
4-07-060-97 - Specify in Comments: Breathing Loss
4-07-060-98 - Specify in Comments: Working Loss

Isocyanates

- 4-07-064-01 - MDI: Breathing Loss
4-07-064-02 - MDI: Working Loss
4-07-064-03 - TDI: Breathing Loss
4-07-064-04 - TDI: Working Loss
4-07-064-97 - Specify Isocyanate: Breathing Loss
4-07-064-98 - Specify Isocyanate: Working Loss

Ketones

- 4-07-068-01 - Cyclohexanone: Breathing Loss
4-07-068-02 - Cyclohexanone: Working Loss
4-07-068-97 - Specify Ketone: Breathing Loss
4-07-068-98 - Specify Ketone: Working Loss

Nitriles

- 4-07-076-01 - Acrylonitrile: Breathing Loss
4-07-076-02 - Acrylonitrile: Working Loss
4-07-076-97 - Specify Nitrile: Breathing Loss
4-07-076-98 - Specify Nitrile: Working Loss

Nitro Compounds

- 4-07-080-01 - Nitrobenzene: Breathing Loss
4-07-080-02 - Nitrobenzene: Working Loss
4-07-080-97 - Specify in Comments: Breathing Loss
4-07-080-98 - Specify in Comments: Working Loss

Phenols

- 4-07-084-01 - Nonylphenol: Breathing Loss
4-07-084-02 - Nonylphenol: Working Loss
4-07-084-03 - Phenol: Breathing Loss
4-07-084-04 - Phenol: Working Loss
4-07-084-97 - Specify Phenol: Breathing Loss
4-07-084-98 - Specify Phenol: Working Loss

Aldehydes

- 4-07-172-01 - Acetaldehyde: Standing Loss
4-07-172-02 - Acetaldehyde: Withdrawal Loss
4-07-172-03 - Acrolein: Standing Loss
4-07-172-04 - Acrolein: Withdrawal Loss
4-07-172-05 - N-Butraldehyde: Standing Loss
4-07-172-06 - N-Butraldehyde: Withdrawal Loss
4-07-172-07 - Formaldehyde: Standing Loss
4-07-172-08 - Formaldehyde: Withdrawal Loss
4-07-172-09 - Isobutyaldehyde: Standing Loss
4-07-172-10 - Isobutyaldehyde: Withdrawal Loss
4-07-172-11 - Propionaldehyde: Standing Loss
4-07-172-12 - Propionaldehyde: Withdrawal Loss
4-07-172-97 - Specify Aldehyde: Standing Loss
4-07-172-98 - Specify Aldehyde: Withdrawal Loss

Alkanes (Paraffins)

- 4-07-176-01 - Cyclohexane: Standing Loss
4-07-176-02 - Cyclohexane: Withdrawal Loss
4-07-176-03 - N-Hexane: Standing Loss
4-07-176-04 - N-Hexane: Withdrawal Loss
4-07-176-05 - N-Pentane: Standing Loss
4-07-176-06 - N-Pentane: Withdrawal Loss
4-07-176-97 - Specify Alkane: Standing Loss
4-07-176-98 - Specify Alkane: Withdrawal Loss

Alkenes (Olefins)

- 4-07-180-01 - Isoprene: Standing Loss
- 4-07-180-02 - Isoprene: Withdrawal Loss
- 4-07-180-03 - Methylallene: Standing Loss
- 4-07-180-04 - Methylallene: Withdrawal Loss
- 4-07-180-05 - 1-Pentene: Standing Loss
- 4-07-180-06 - 1-Pentene: Withdrawal Loss
- 4-07-180-07 - Piperylene: Standing Loss
- 4-07-180-08 - Piperylene: Withdrawal Loss
- 4-07-180-09 - Cyclopentene: Standing Loss
- 4-07-180-10 - Cyclopentene: Withdrawal Loss
- 4-07-180-97 - Specify Alkene: Standing Loss
- 4-07-180-98 - Specify Alkene: Withdrawal Loss

Ethers

- 4-07-208-01 - Ethyl Ether: Standing Loss
- 4-07-208-02 - Ethyl Ether: Withdrawal Loss
- 4-07-208-03 - Propylene Oxide: Standing Loss
- 4-07-208-04 - Propylene Oxide: Withdrawal Loss
- 4-07-208-97 - Specify Ether: Standing Loss
- 4-07-208-98 - Specify Ether: Withdrawal Loss

Halogenated Organics

- 4-07-220-01 - Carbon Tetrachloride: Standing Loss
- 4-07-220-02 - Carbon Tetrachloride: Withdrawal Loss
- 4-07-220-03 - Chloroform: Standing Loss
- 4-07-220-04 - Chloroform: Withdrawal Loss
- 4-07-220-05 - Ethylene Dichloride: Standing Loss
- 4-07-220-06 - Ethylene Dichloride: Withdrawal Loss
- 4-07-220-07 - Methylene Chloride: Standing Loss
- 4-07-220-08 - Methylene Chloride: Withdrawal Loss
- 4-07-220-09 - 1,1,1-Trichloroethylene: Standing Loss
- 4-07-220-10 - 1,1,1-Trichloroethylene: Withdrawal Loss
- 4-07-220-97 - Specify in Comments: Standing Loss
- 4-07-220-98 - Specify in Comments: Withdrawal Loss

Ketones

- 4-07-228-01 - Acetone: Standing Loss
- 4-07-228-02 - Acetone: Withdrawal Loss
- 4-07-228-03 - Methyl Ethyl Ketone: Standing Loss
- 4-07-228-04 - Methyl Ethyl Ketone: Withdrawal Loss
- 4-07-228-05 - MIBK: Standing Loss
- 4-07-228-06 - MIBK: Withdrawal Loss
- 4-07-228-97 - Specify Ketone: Standing Loss
- 4-07-228-98 - Specify Ketone: Withdrawal Loss

Mercaptans (Thiols)

- 4-07-232-01 - Ethyl Mercaptan: Standing Loss
- 4-07-232-02 - Ethyl Mercaptan: Withdrawal Loss
- 4-07-232-97 - Specify Mercaptan: Standing Loss
- 4-07-232-98 - Specify Mercaptan: Withdrawal Loss

ORGANIC CHEMICAL STORAGE - PRESSURE TANKS -**MAJOR GROUPS 28, 29, 30, 51****Alkanes (Paraffins)**

- 4-07-816-01 - Ethane: Withdrawal Loss
- 4-07-816-02 - Butane: Withdrawal Loss
- 4-07-816-03 - Methane: Withdrawal Loss
- 4-07-816-04 - Natural Gas: Withdrawal Loss
- 4-07-816-05 - Propane: Withdrawal Loss
- 4-07-816-99 - Specify Alkane: Withdrawal Loss

Alkenes (Olefins)

- 4-07-820-01 - 1,3-Butadiene: Withdrawal Loss
- 4-07-820-02 - 1-Butene: Withdrawal Loss
- 4-07-820-03 - 2-Butene: Withdrawal Loss
- 4-07-820-04 - Ethylene: Withdrawal Loss
- 4-07-820-05 - Isobutylene: Withdrawal Loss
- 4-07-820-06 - Propylene: Withdrawal Loss
- 4-07-820-99 - Specify Alkene: Withdrawal Loss

Alkynes (Acetylenes)

- 4-07-824-01 - Acetylene: Withdrawal Loss
- 4-07-824-99 - Specify Alkyne: Withdrawal Loss

Amines

- 4-07-832-01 - Methylamine: Withdrawal Loss
- 4-07-832-02 - Dimethylamine: Withdrawal Loss
- 4-07-832-03 - Trimethylamine: Withdrawal Loss
- 4-07-832-99 - Specify Amine: Withdrawal Loss

Ethers

- 4-07-848-01 - Ethylene Oxide: Withdrawal Loss
- 4-07-848-99 - Specify Ether: Withdrawal Loss

Halogenated Organics

- 4-07-860-01 - Ethyl Chloride: Withdrawal Loss
- 4-07-860-02 - Methyl Chloride: Withdrawal Loss
- 4-07-860-03 - Phosgene: Withdrawal Loss
- 4-07-860-04 - Vinyl Chloride: Withdrawal Loss
- 4-07-860-99 - Specify in Comments: Withdrawal Loss

Isocyanates

- 4-07-864-01 - Methyl Isocyanate: Withdrawal Loss
- 4-07-864-99 - Specify Isocyanate: Withdrawal Loss

Mercaptans (Thiols)

- 4-07-872-01 - Methyl Mercaptan: Withdrawal Loss
- 4-07-872-99 - Specify Mercaptan: Withdrawal Loss

ORGANIC CHEMICAL TRANSPORTATION -**MAJOR GROUPS 28, 29, 30, 51****Specify Liquid**

- 4-08-999-99 - Loading Rack

ORGANIC SOLVENT EVAPORATION - MISCELLANEOUS**Solvent Extraction Processes**

- 4-90-001-01 - Petroleum Naphtha (Stoddard)
- 4-90-001-02 - MEK
- 4-90-001-03 - MIBK
- 4-90-001-04 - Furfural
- 4-90-001-05 - Trichloroethylene
- 4-90-001-99 - Other Not Classified
(Specify in Comments)

Waste Solvent Recovery Operations

- 4-90-002-01 - Storage Tank Vent
- 4-90-002-02 - Condenser Vent
- 4-90-002-03 - Incinerator Stack
- 4-90-002-04 - Solvent Spillage
- 4-90-002-05 - Solvent Loading
- 4-90-002-06 - Fugitive Leaks
- 4-90-002-99 - Other Not Classified
(Specify in Comments)

Rail Car Cleaning - 4742, 4011, 4013
4-90-003-01 - Low Vapor Pressure, High Viscosity Cargo (Ethyene Glycol)
4-90-003-02 - Medium Vapor Pressure, Medium Viscosity Cargo (Chlorobenzene)
4-90-003-03 - Low Vapor Pressure, Medium Viscosity Cargo (o-Dichlorobenzene)
4-90-003-04 - Low Vapor Pressure, High Viscosity Cargo (Creosote)
4-90-003-99 - Other Not Classified (Specify in Comments)

Tank Truck Cleaning - 7699

4-90-004-01 - High Vapor Pressure, Low Viscosity Cargo (Acetone)
4-90-004-02 - High Vapor Pressure, Low Viscosity Cargo (Perchloroethylene)
4-90-004-03 - Medium Vapor Pressure, Medium Viscosity Cargo (Methyl Methacrylate)
4-90-004-04 - Low Vapor Pressure, Low Viscosity Cargo (Phenol)
4-90-004-05 - Low Vapor Pressure, High Viscosity Cargo (Propylene Glycol)
4-90-004-99 - Other Not Classified (Specify in Comments)

Organic Solvent Evaporation - Fuel Fired Equipment

Incinerators

4-90-900-11 - Distillate Oil (No. 2)
4-90-900-12 - Residual Oil
4-90-900-13 - Natural Gas

Flares

4-90-900-21 - Distillate Oil (No. 2)
4-90-900-22 - Residual Oil
4-90-900-23 - Natural Gas

Miscellaneous Volatile Organic Compound Evaporation

4-90-999-98 - Identify the Process and the Solvent in Comments
4-90-999-99 - Identify the Process and the Solvent in Comments

SOLID WASTE DISPOSAL - GOVERNMENT

Municipal Incineration - 4953
5-01-001-01 - Multiple Chamber
5-01-001-02 - Single Chamber

Open Burning Dump

5-01-002-01 - General Refuse
5-01-002-02 - Vegetation Only

Other Incineration

5-01-005-05 - Pathological
5-01-005-06 - Sludge
5-01-005-07 - Conical Design (Tee Pee) Municipal Refuse
5-01-005-08 - Conical Design (Tee Pee): Wood Refuse
5-01-005-10 - Trench Burner: Wood
5-01-005-11 - Trench Burner: Tires
5-01-005-12 - Trench Burner: Refuse

Firefighting

5-01-006-01 - Structure: Jet Fuel
5-01-006-02 - Structure: Distillate Oil
5-01-006-03 - Structure: Kerosene
5-01-006-04 - Structure: Wood Pallets

Sewage Treatment

5-01-007-01 - Entire Plant
5-01-007-02 - Primary Settling Tank
5-01-007-03 - Secondary Settling Tank
5-01-007-04 - Aeration Tank

Auxillary Fuel/No Emissions

5-01-900-05 - Distillate Oil
5-01-900-06 - Natural Gas
5-01-900-10 - Liquified Petroleum Gas (LPG)

SOLID WASTE DISPOSAL - COMMERCIAL/INSTITUTIONAL

Incineration - General

5-02-001-01 - Multiple Chamber
5-02-001-02 - Single Chamber
5-02-001-03 - Controlled Air
5-02-001-04 - Conical Design: Municipal Refuse
5-02-001-05 - Conical Design: Wood Refuse

Open Burning

5-02-002-01 - Wood
5-02-002-02 - Refuse

Apartment Incineration

5-02-003-01 - Flue Fed
5-02-003-02 - Flue Fed (With Afterburner and Draft Controls)

Incineration (Special Purpose)

5-02-005-05 - Pathological Waste
5-02-005-06 - Sludge

Landfill Dump

5-02-006-01 - Waste Gas Flare
5-02-006-02 - Municipal: Fugitive Emissions

Auxillary Fuel/No Emissions

5-02-900-05 - Distillate Oil
5-02-900-06 - Natural Gas
5-02-900-10 - Liquified Petroleum Gas (LPG)

SOLID WASTE DISPOSAL - INDUSTRIAL

Incineration

5-03-001-01 - Multiple Chamber
5-03-001-02 - Single Chamber
5-03-001-03 - Controlled Air
5-03-001-04 - Conical Design: Refuse
5-03-001-05 - Conical Design: Wood Refuse
5-03-001-06 - Trench Burner: Wood
5-03-001-07 - Trench Burner: Tires
5-03-001-08 - Auto Body Components
5-03-001-09 - Trench Burner: Refuse

Open Burning

5-03-002-01 - Wood/Vegetation/Leaves
5-03-002-02 - Refuse
5-03-002-03 - Auto Body Components
5-03-002-04 - Coal Refuse Piles

Incineration

5-03-005-06 - Sludge

Landfill Dump

5-03-006-01 - Waste Gas Flare

5-03-006-02 - Liquid Waste Disposal

5-03-006-03 - Hazardous: Fugitive Emissions

Liquid Waste

5-03-007-01 - General

Treatment, Storage, and Disposal Facilities: Fugitive Emissions

5-03-008-01 - Surface Impoundment

5-03-008-10 - Waste Piles

5-03-008-20 - Land Treatment

5-03-008-30 - Containers

Auxillary Fuel/No Emissions

5-03-900-05 - Distillate Oil

5-03-900-06 - Natural Gas

5-03-900-10 - Liquified Petroleum Gas (LPG)

APPENDIX 7-2

GUIDELINE FOR DETERMINATION OF EMISSION LIMITS

APPENDIX 7-2

GUIDELINE FOR DETERMINATION OF EMISSION LIMITS

1. INTRODUCTION

This guideline documents the policies and requirements of the Ontario Ministry of the Environment used in setting emission limits under the Clean Air Program. These requirements draw on the experience of the United States Environmental Protection Agency (U.S. EPA) and the Northeastern States for Coordinated Air Use Management (NESCAUM) in setting technology-based emission limits. They have been developed specifically to meet the needs of the Clean Air Program philosophy and Ontario's environmental legislation and regulations.

In the United States, regulations issued under the Clean Air Act require new sources entering regions which currently attain the National Ambient Air Quality Standards (NAAQS) to use Best Available Control Technology (BACT) in order to achieve the Prevention of Significant Deterioration (PSD). The EPA has recently issued instructions to the effect that BACT determinations are to be made on a "top-down" basis, i.e., by establishing what degree of control is strictest for a given combination of pollutant and source and working through less stringent control requirements based on considerations of environmental, energy and economic impacts and other costs.

Two significant guidance documents have been issued to interpret this requirement that BACT be determined "top-down." The first was EPA Region 9's "Guidelines for Determining Best Available Control Technology (BACT)," dated April 1987. More recently, NESCAUM has produced its "BACT Guideline," dated October 1988. The NESCAUM document draws on the Region 9 guideline, with a different emphasis in several areas. The Ministry of the Environment has drawn on both as initial bases for this guideline.

2. BACKGROUND

In November 1987, the Ministry of the Environment issued a discussion paper outlining options for the Clean Air Program. Three philosophical points formed the basis for the proposals:

1. The primary means of achieving air pollution control should involve limiting emissions at the source rather than allowing their dilution in the air;
2. The emissions of toxic air pollutants should be virtually eliminated from sources in Ontario; and
3. The emissions of all air pollutants should be controlled as a matter of responsible stewardship of the environment.

The Clean Air Program divides air pollutants into three Levels of Concern. These Levels delineate differing degrees of environmental hazard posed by these substances, with emphasis on effects on human health. The degree of control stringency required for each contaminant is tied to the degree of environmental hazard (the Level of Concern) associated with it. The Level of Concern is thus also the level of control. The correspondence between the two is as follows:

- Level of Concern 1: Contaminants which present a high hazard to the environment, for example due to known or probable human carcinogenicity and/or persistence or tendency to bioaccumulate in the environment. Control is aimed at virtually eliminating these pollutants - the strictest controls required anywhere in the world are to be used. Economic factors may be considered in implementation, but not in establishing the emission limit.
- Level of Concern 2: Contaminants which are of significant concern in the environment, for example due to other effects on genetic material (possible carcinogenicity, teratogenicity), ability to affect distant receptors due to long range transport and/or transformation in the atmosphere. Control is aimed at minimizing emissions of such compounds to the greatest extent feasible - the best controls demonstrated in use anywhere in the world are to be used, taking into consideration economic factors.
- Level of Concern 3: Contaminants which are of moderate concern in the environment, for example because significant nuisance effects require control to levels well below the onset of any health effect (e.g., odours or soiling) and which have no known environmental impacts at such nuisance levels. Control is aimed at providing reasonable abatement of emissions to avoid the nuisance in accord with the philosophy of responsible stewardship. Economic factors are considered in establishing the emission limit.

The method used to ensure control is to set emission limits based on the requirements or demonstrated control levels in Ontario and elsewhere. The proponent (the owner and/or operator of a source of emissions) is free to use whatever means seem reasonable to achieve the limit in an actual proposal. The procedures outlined in this document are intended to yield values for emission limits, not requirements to use the technologies which happen to lead to those limits.

3. PURPOSE

This guideline provides the general procedures to be used in reviewing requirements and achievements in air pollution control on a consistent basis to arrive at appropriate emission limits for a source. For the purposes of setting emission limits, the term "source" refers to

an individual point of emission or, where there is no particular point of emission, to the process or area from which contaminants originate. Also, where several differing pieces of equipment giving rise to distinct mixtures of pollutants happen to be ducted to a common exhaust stack, the originating equipment is to be regarded as the source rather than the common stack. Fugitive sources (e.g., outdoor storage piles and leaks from valves, seals or flanges) are included as sources to be considered, however the control limits set for such sources may be procedures rather than numerical limits. This document does not address the setting of procedural limits.

This document focuses on the type of data required in a submission to support a numerical emission limit determination, and how the data may be used to arrive at the set of emission limits applicable to a source.

For cases where the Ministry has provided no emission limits for a particular source/pollutant combination, or where the existing emission limits are more than 12 months out of date, the responsibility for proposing the emission limit rests with the applicant. Environment Ontario will review the proponent's submission to determine whether it meets the relevant control requirements. The top-down approach adopted for arriving at emission limits places a particular responsibility on the applicant to present and defend its proposal.

The level of analysis (or documentation) to support emission limit proposals should be consistent from region to region within Ontario. However, the process is intended to address control on a case-by-case basis; indeed, under CAP it is intended to provide a technology-forcing or evolutionary aspect to the process of setting emission limits. As a result, new facilities built at different times, even if located close to each other, will not necessarily have the same emission limits even if they are otherwise virtually identical. Consistency in this context means that the impacts of alternative emission control systems are measured by the same set of criteria. At the same time, it is intended that existing sources should be required to review the control technology in use with comparisons to those at new facilities. Sources emitting chemicals of all three levels of concern are expected to update if the state of the art has advanced substantially.

4. APPLICABILITY

Under CAP, emission limits would be requirements where the Small Source Designation Limit (SSDL) for a pollutant is exceeded by the Potential to Emit from the source which will be seeking approval. It is also intended that Air Quality Standards (AQS) will be set to represent the ultimate impact acceptable in the environment. Applicants considering controls which would not meet an AQS requirement would be subject to additional review requirements aimed at ensuring attainment of the AQS. These might include, but would not necessarily be limited to, implementation of more stringent controls (if LAER is not proposed) or use of a supplementary control strategy acceptable to the Ministry. At the same time, applicants should not consider that the AQS is a level which they are entitled to "pollute up" to. It is a ceiling value to be avoided by the largest margin reasonable given the nature of the pollutant.

5. IDENTIFICATION OF CONTROL ALTERNATIVES

The first step in the analysis of potential emission limits is identification of the most stringent control possible (usually referred to as the Lowest Achievable Emission Rate, or LAER) in terms of emission quantities, optimized for all contaminants emitted from the source. The optimization of emissions involves estimating the quantities of each pollutant emitted for each identifiable control alternative. These quantities should then be divided by the SSDLs for each pollutant or class of pollutants, yielding an Emission Magnitude Ratio (EMR). The EMRs for the range of pollutants are then summed for each control option, and the option yielding the lowest sum is considered to be the most stringent control.

This then becomes the basis of comparison for the remainder of the analysis. It is important for the applicant be in concurrence with the Ministry of the Environment as to what is the most stringent control case. It should also be noted that the optimization of emissions should take into account all feasible combinations of control technologies or strategies.

At this stage of the technology review process, no technically feasible alternative should be eliminated as a possible candidate. Controls used on *similar* source categories should be taken into account as well as existing controls for the source category in question. Of course, the identified alternatives should include those representative of LAER for the source or source category.

The initial assumption in reviewing the control alternatives is to assume that the capability of the most stringent control possible translates directly into the set of emission limits for the source under review. The burden of proof for applying less stringent emission limits rests in the applicant's evaluation of the identified alternatives. If the most stringent emission limits are adopted by the applicant, the review is complete.

Failing to address the top case in an attempt to avoid stringent controls will result in the process being delayed while the applicant is required to reassess alternatives against the control option Environment Ontario determines to be the top case.

When searching the record to identify the top case, the applicant must seek information on control technologies used throughout Canada and the United States, and should investigate any applicable technologies used in other foreign jurisdictions. As examples, Scandinavian pulping facility controls, German boiler and incinerator technology and operation controls, and Japanese controls for flue gas desulphurization have traditionally met very stringent emission limits. Source measurement data may also be available on such technologies to assist in assessing the performance of a specific technology. In this context, the performance of interest is the emission control performance in terms of long-term emission levels. This combines aspects of removal efficiency and reliability.

5.1. Types of Controls

When reviewing alternative control technologies to determine the top case and candidate alternatives for detailed assessment, the following types of controls should be considered.

5.1.1. EXISTING CONTROL TECHNOLOGY: A control technology which has been proven in practice for the source category. This should include both emission limitations imposed by other jurisdictions and test results which reflect what was actually achieved in performance.

5.1.2. TECHNICALLY FEASIBLE ALTERNATIVES: A control technology which has been demonstrated in practice on other source categories but has not been demonstrated in practice on the class or category of source under review. Applying a control technology to a source category in which it has not been demonstrated is called control technology transfer.

5.1.3. INNOVATIVE CONTROL TECHNOLOGY: A control technology which has never been applied to any source on a full scale, continuously operating basis. This technology may be chosen on the basis of pilot scale or short-term testing. In selecting an innovative control technology, there must be some reasonable level of expectation that the innovative options will out-perform the demonstrated control.

5.1.4. USE OF PRODUCTION PROCESSES, FUELS, AND OTHER RAW MATERIALS WHICH ARE INHERENTLY LESS POLLUTING: These options may be evaluated alone or in combination with add-on pollution control devices. Examples include use of low-volatile coatings in printing and painting, use of methanol as a fuel to reduce NO_x emissions, and switching from coal to natural gas to reduce heavy metal, trace organic compounds, NO_x and SO₂ emissions.

5.1.5. SPECIFIC DESIGN OR OPERATIONAL PARAMETERS: These options may include such factors as combustion zone temperature, combustion zone residence time, automatic combustion controls, pressure drop across control equipment, and more.

Both the applicant and Ministry review staff should consider the use of clean processes, fuels and raw materials which are inherently less polluting than what has been historically employed by a particular industry. The analyses for these alternatives should be conducted in the same manner as the review for more conventional alternatives, as described subsequently in this document. The Ministry will seriously consider requiring the use of such alternatives if the analysis justifies their use by way of impacts in other environmental media. Examples of areas where such trade-offs may be possible include removal of recyclable materials from incinerator feed streams through source separation programs; selection of dry dust removal technologies versus wet scrubbers; use of powder coatings versus solvent-borne coatings; gas versus fuel oil as a fuel; and electric-boost or all-electric glass furnaces versus fossil fuel fired units.

In the case of sources emitting only Level 3 pollutants, the aim is to achieve reasonable control rather than necessarily maintaining the state of the art. In such cases, innovative control technologies need not usually be reviewed, and requirements in jurisdictions outside of North America may not need to be referenced, provided that a reasonable number of alternatives can be identified from the open record on similar or identical sources in Canada and the United States.

5.2. Sources of Information on Control Alternatives

There are many sources of information on control alternatives for various source categories. The following sources are representative of those which will be checked by the Ministry in reviewing an applicant's submission. They should thus be regarded as the minimum list to be considered by the applicant in preparing the technology review for submission.

5.2.1. U.S. EPA BACT/LAER CLEARINGHOUSE: All applicants should check the BACT/LAER Clearinghouse prior to submitting their application. The information available from the Clearinghouse should be summarized in the submission. Environment Ontario will verify that this information is correct and up to date.

5.2.2. U.S. EPA NATIONAL AIR TOXICS INFORMATION CLEARINGHOUSE (NATICH): All applicants should check with NATICH for relevant data prior to submitting their application. The information available from this source should be summarized in the submission. Environment Ontario will verify that this information is correct and current.

5.2.3. ENVIRONMENT CANADA/OTHER PROVINCES/U.S. EPA, STATE AND LOCAL PERMITS/APPROVALS: Applicants should be aware of approvals issued for their industry. An effort must be made to obtain current information on controls equivalent to the level required for these sources. Environment Ontario will retain documentation of recent determinations of emission limits.

5.2.4. CANADIAN AND US FEDERAL/PROVINCIAL AND STATE/LOCAL APPROVALS STAFF: Review staff and managers can provide information on projects under review for which relevant information for emission limits determinations may be available. In the US, BACT analyses under consideration will be available from these individuals before it appears in the Clearinghouse manual.

5.2.5. CONTROL EQUIPMENT VENDORS: Vendors have information on the most recent control technology, cost information, emission guarantees, and test results.

5.2.6. TRADE ASSOCIATIONS: Associations serving one sector often maintain permitting and emission test reports. Examples include the National Council for Air and Stream Improvement (NCASI) for the US pulp and paper industry and the Canadian Pulp and Paper Association's Environment Committee; the Electric

Power Research Institute (EPRI) for the US electric power industry and the Canadian Electrical Association (CEA); and the Industrial Gas Cleaning Institute (IGCI), representing air pollution control equipment vendors, for information on air pollution control equipment.

5.2.7. AGENCIES OR COMPANIES OUTSIDE CANADA AND THE UNITED STATES:

These should be consulted for information on the most recent advances in control technologies, control costs, test results and other relevant information.

5.2.8. INSPECTION/PERFORMANCE TEST REPORTS: Recent test data may be useful to establish emission limits. Inspection and performance test data may also reveal potential problem areas with a control technology or specific equipment.

5.2.9. TECHNICAL LITERATURE: A thorough search of the available published literature will provide both information on the specific sources and technologies concerned, and contacts for follow-up. This is especially useful for identifying appropriate contacts in agencies or companies outside Canada and the United States. Through on-line (computerized) bibliographic search and retrieval services such as DIALOG, BRS, and their competitors, relevant papers and reports can be found and even ordered in most cases.

6. EFFECTIVENESS RANKING OF CONTROL ALTERNATIVES

Once the applicant has identified the appropriate control alternatives, they are to be ranked in order of their (optimized) control effectiveness and presented in the submission in the ranked order with the most effective control alternative at the top. This list must present an array of control alternatives, showing for each the control efficiencies, expected controlled emission rates of emitted contaminants, environmental impacts or benefits (either in other media or as secondary air emissions), and estimated costs (given as overall cost effectiveness values). The applicant is to prepare a chart for each source (or small group of sources) in the analysis, showing all emitted pollutants' quantities for each control alternative. These charts will be used to compare the control alternatives and to focus the selection of an optimum set of emission limits as those applicable to the source(s) under consideration. The actual control technology proposed for use will likely also follow from this comparison.

7. EVALUATION OF CONTROL ALTERNATIVES

Environment Ontario will consider a list of criteria similar to that used by the US EPA for arriving at BACT in determining emission limits involving Level 2 or 3 pollutants. First, technical feasibility is addressed in selecting alternatives for consideration. Second, the potential for significant adverse impacts on environmental media other than air, or significant adverse secondary impacts on air quality associated with a particular technology

should be evaluated for each alternative and compared. Third, economic factors will be examined in establishing the emission limits for Level 2 and Level 3 contaminants.

If Level 1 pollutants are present in amounts above their SSDLs, only technical feasibility and "other" environmental effects (e.g., secondary emissions, non-air quality impacts) are eligible to be considered in the evaluation for setting the emission limit(s). Economic factors may be considered in the implementation of these limits.

Since Environment Ontario will use these criteria in its assessment of the review, it is important that applicants provide fully documented estimates of: the emissions of all relevant pollutants using alternative control technologies; quantitative and qualitative non-emission environmental impacts as described subsequently; and costs for each alternative, especially when presenting site-specific assessments. The evaluation should proceed in an incremental manner, from the top down.

The first step in this approach is to determine, for the emission source in question, the most stringent control available for a similar or identical source or source category. If it can be shown that this level of control is inappropriate for the subject source due to technical feasibility questions, unacceptable environmental impacts caused by cross-media contamination or secondary air emissions, or economic factors, then the applicant should determine the next most stringent level of control and evaluate it in a similar fashion. This process continues until the control level under consideration cannot be eliminated by any substantial or unique technical, environmental or economic objection.

This top-down approach shifts the burden of proof to the applicant, who must justify why the proposed source is unable to apply the best technology available. It also differs from other evaluation systems possible in that it requires the applicant to analyze a control technology only if the applicant opposes the level of control corresponding to LAER. Most other evaluation processes require a full analysis of all possible types and levels of control above some baseline case.

8. IMPACT ANALYSIS OF CONTROL ALTERNATIVES

The effectiveness of the control alternatives at controlling the emissions from the source is the decisive factor in determining any emission limits. The impact analysis is nonetheless an important part of the selection process.

The applicant should estimate the net environmental impact associated with each control alternative. Both beneficial and adverse impacts should be discussed and, wherever possible, quantified. The analyses should be presented in the form of the incremental impact of each control alternative relative to the most stringent system identified as a control alternative.

The determination of the emission limit(s) for a source, however, is intended to aid in the reduction of such emissions to a reasonable extent. As a result, insignificant air quality impact in particular will generally not provide the basis for accepting a less stringent control technology, unless other factors also indicate that this is appropriate. Usually, the

only case where the modelled impact of the proposed emissions will influence a source's final emission limitation is when that modelling shows exceedances of the Air Quality Standards. In this case, the applicant must choose between using a more stringent degree of control, implementation of supplementary controls if feasible, or changing site location.

When weighing environmental impacts, the applicant should consider all air pollutants emitted and the impact on other environmental media due to each control alternative. This includes any air pollutants not listed by Environment Ontario as having any Air Quality Standard but which may have a potential to cause an adverse effect. The analysis of such unlisted air pollutants should be directed at developing an inventory of potential pollutants from a proposed source and evaluating the impact of each control alternative under consideration in terms of its impact on emissions of the unlisted pollutants.

The following is a brief outline of some, but by no means all, of the environmental categories that should be considered during an analysis of environmental impacts.

1. Impacts on air quality
 - visible emissions
 - odour
 - visibility impairment
 - unlisted pollutants
 - secondary air emission sources unique to a particular control alternative (e.g. fugitive particulate emissions, emissions from special unit operations)
2. Impacts on water quality/liquid discharges
3. Solid waste disposal impacts
4. Other environmental impacts
5. Noise
6. Condensed water plumes from wet scrubbers, cooling towers
7. Potential for accidental releases
8. Reliability (e.g. potential for malfunction and down time)

The impact analysis should be conducted in a reasonable fashion when comparing these factors. For example, where waste water treatment technology is commonly available for liquid discharges associated with a control alternative, the treated effluent quality should form the basis for noting water quality impacts. The costs of such treatment will be addressed in any economic analysis which may be performed.

9. ASSESSING ECONOMIC IMPACTS

The economic assessment will feed into the process of determining the emission limit. A complete assessment may not be required for all applications. For example, no assessment will be required if the proponent adopts the most stringent emission limit, or if the most stringent limit has been eliminated due to considerations involving technical feasibility or "other" environmental impacts. Components of the economic assessment may include:

1. Cost estimation
2. Cost-effectiveness analyses

3. Analyses of economic and financial consequences

Specific criteria for evaluating the economic and financial consequences will be developed over the public review period, based on public input.

In evaluating the economics of control options for determining Level 2 or 3 emission limits, the economic situation of the source/applicant is relevant but not necessarily overriding. A major purpose of the costing exercise is to evaluate the overall cost effectiveness of each option, expressed in dollars per total Mg of pollutant removed.

9.1. Cost Estimation

The applicant should show the estimates for the costs of each emission control alternative. These should include any supporting data, and an itemization and explanation of the procedures used to assess the economic impacts, any supporting data, and an itemization and explanation of all costs assigned to each option. Credit for tax incentives should be included, as well as credits for product recovery and any byproduct sales generated due to the use of each control alternative.

The following types of information should be assembled to develop cost estimates for each relevant control alternative:

1. Capital costs relevant to the type and scale of each abatement technology, based on the source's maximum design capacity for operation 8,760 hours per year. If the facility is seeking approval to operate for less than 8,760 hours per year, the analysis may include data based on the operation for which approval is sought in addition to that based on 8,760 hours per year.
2. Capital costs should be desegregated into:
 - (a) Engineering and planning,
 - (b) Construction and installation,
 - (c) Equipment and machinery, and
 - (d) Land acquisition.
3. Operating and maintenance (O & M) costs, including those associated with monitoring, for a typical year. Where relevant and possible, labour requirements should be enumerated in units of person-years of effort.
4. Operating life of abatement technologies or control alternatives, in years. The values shown in Table 1 should be used where relevant unless the applicant can provide data to support another value.

5. Minimum installation time, in years, of each control alternative, and the extent to which rapid installation may affect costs or reliability of the control measure.
6. **Private benefits** of each control alternative, including reduced energy or materials requirements, saleable byproducts, reduced labour requirements, enhanced production efficiencies or improvements to product quality. These benefits and their potential annual totals should be displayed separately, but then subtracted from relevant costs to determine **Net Costs**.

Total capital and O & M costs for each control alternative are estimated by adding the relevant capital and O & M costs for each component of abatement technology involved in that alternative. Where uncertainties exist, sensitivity analyses should be undertaken.

In order to compare net costs between control alternatives, as well as to sum net costs among plants for economic analyses, cost estimates will have to be converted to both **annualized costs** and **discounted present values**. Such conversions permit one-time capital expenditures for equipment which lasts for a number of years to be considered simultaneously with annual operating and maintenance expenses. Also, costs are to be expressed in constant dollars to abstract from the consequences of inflation. Such adjustments and conversions permit the comparison of expenditures occurring at different times.

Annualized costs are computed by multiplying capital costs by an appropriate annualization factor based on an interest rate and the life-time of the relevant abatement technologies. This annualized capital cost is then added to the typical annual O & M cost. The annualization of capital costs should be based on the data shown in Table 1, unless the applicant can provide information to support another value.

TABLE 1: Typical Design Life for Air Pollution Control Equipment

EQUIPMENT LIFE (years)	LOW	AVERAGE	HIGH
CONTROL TECHNOLOGY			
Electrostatic Precipitators	5	20	40
Venturi Scrubbers	5	10	20
Fabric Filters	5	20	40
Thermal Incinerators	5	10	20
Catalytic Incinerators	5	10	20
Adsorbers	5	10	20
Absorbers	5	10	20
Refrigeration	5	10	20
Flares	5	15	20

Source: Capital and Operating Costs of Selected Air Pollution Control Systems, EPA 450/5-80-002, December 1978.

Present values are calculated by multiplying both annual O & M costs and capital expenses that will be incurred over a relevant time horizon in the future by appropriate present value factors. Present values of future O & M and capital costs are then added to expenditures that are incurred during the current year.

The applicant is responsible for fully documenting all applicable cost information. Vendor quotations or other reliable means should be the primary basis for estimates. Other sources include estimates derived using the most recent methods documented in the US EPA document, Capital and Operating Costs of Selected Air Pollution Control Systems (EPA 450/5-80-002, December 1978), the OAQPS Control Cost Manual, Fourth Edition (EPA 450/3-90-006, January 1990), and any subsequent revisions to these manuals. Whenever the cost estimates involve equipment sizes outside the ranges covered in those documents, the applicant is responsible for providing data to support the estimates. The year used as the basis for the cost estimates must be clearly designated, and all calculations should be adjusted to reflect that one year's costs.

9.2. Cost-Effectiveness Analyses

For each control alternative, a cost per unit of pollutant removed is to be calculated. The cost figure used in this ratio will be the annualized amount (annualized capital plus typical annual O & M). The unit of pollution removed will be the total mass in Mg of pollutant controlled. The results of the analysis should be presented in a clear, concise format (e.g., a table ranked by cost effectiveness) to permit ready comparison of the costs of controls within the source category under review and between that category and other industries.

9.3. Analyses of Economic and Financial Consequences

Specific criteria will be developed in consultation with the public and industry during the public consultation period.

10. ENFORCEABILITY

The determination of an emission limit must result in a value useful for comparison between processes of varying size, and will thus usually be expressed as an emission factor (i.e. kg pollutant per Mg product produced, or per Mg raw material consumed, or per gigajoule energy input). Units of concentration in an exhaust stream are generally unacceptable, due to the potential for sources appearing to meet such limits through dilution rather than control. These limits are then translated into emission rates or loadings for inclusion as conditions to the certificate of approval for the source. These limits are enforceable as conditions of approval.

As well, all sources will require initial assessment by source testing (or where the conditions specified in Appendix 9 are met, by another emission verification technique acceptable to the Ministry - e.g., mass balance) within twelve months of start-up under

CAP. It is also proposed that they be retested thereafter, at a frequency of at least once annually where Level 1 pollutants are emitted, annually or somewhat less frequently at the discretion of the Director issuing approvals if Level 2 substances are discharged, or otherwise at the discretion of the Director granting approval if only Level 3 contaminants are involved. Adequate records must be kept of the operation, maintenance and process conditions so that the Ministry can verify proper operation of the source's emission controls, be they add-on control devices, process modifications or operating practices. Continuous monitoring and recording of an appropriate parameter reflecting the state of the emissions will be required to this end where Level 1 or 2 contaminants are emitted, but not necessarily if only Level 3 pollutants are discharged.

11. FURTHER INFORMATION

Additional information may be sought by contacting:

Regulatory Issues Coordinator
Regulation Development and Environmental Assessment Unit
Emission Technology and Regulation Development Section
Air Resources Branch
Environment Ontario
880 Bay Street, 4th Floor
Toronto, Ontario M5S 1Z8
Telephone (416) 326-1700
Telecopier (416) 326-1733

APPENDIX 7-3

THE EMISSION LIMIT-SETTING PROCESS

APPENDIX 7-3

THE EMISSION LIMIT-SETTING PROCESS

The Clean Air Program (CAP) uses emission limits set by pollutant and source to achieve control of air pollutants. In this context, Standard Operating Procedures devised to mitigate emissions should be regarded as included in the term "limits." This approach is backed up by the use of dispersion modelling and ambient monitoring, where warranted, to assess compliance with community Air Quality Standards (AQS). However, it is expected that the AQSs will be a second line of defence, and emission limits will control total loadings to the environment as the primary protection mechanism.

Emission limits are to be set for each pollutant emitted from a source type or category. These values will be arrived at in several ways. The initial list promulgated with the revisions to Regulation 308 are based on regulatory requirements obtained from other jurisdictions. From time to time the Ministry of the Environment will consult other jurisdictions worldwide and adopt such requirements as they become accessible.

Where air pollutants are identified which pose particular problems for achieving compliance, the Ministry may undertake special research to develop appropriate control strategies. These may include measures or technologies developed by the Ministry or by associations representing a number of sources. In addition, individual proponents planning the construction of new or modified works which will emit pollutants to the atmosphere will be required to submit up to date reviews of other jurisdictions' regulatory requirements and performance data on other installations.

An owner or operator of an existing or proposed source of emissions will be aware of the need to obtain approvals at least two years in advance of the deadline by which they must be obtained, where the need is imposed by the Ministry in phasing in the CAP requirements. When the decision has been made to apply for approval, but before actual design work begins, proponents must determine whether there are current emission limits for their source category and emitted pollutants. Current emission limits are values added to the list of standards within the last 12 months. If there are such standards, proponents are to obtain written confirmation of this from the Ministry.

If there are no current standards, proponents must initiate a Technology Review with the aim of establishing current standards. This is to be done in accordance with the Guideline for Determination of Emission Limits (Appendix 7-2). Where no emission limits have ever been produced for the source and contaminants under examination, the Technology Review will need to be extensive. Where outdated emission limits exist, the Review need only cover the period between the derivation of the old values and the present.

The completed Technology Review is to be submitted to the Ministry, recommending a set of emission limits for the source(s) in question. Opportunities for public consultation to involve interested parties would be sought in accord with the level of concern associated with the source type. The exact mechanism for soliciting input is not established at this

point and the Ministry is interested in hearing preferences from reviewers coming out of the comment period for this draft regulation.

The Ministry staff assigned to evaluate the submission will set new standards based on the documentation received and taking into account any parallel assessment they may perform. These standards will be incorporated into the list in the revised regulation after being published as proposals in the Ontario Gazette. Any party may appeal the setting of an emission limit to the Environmental Appeal Board during the 30-day period following publication in the Ontario Gazette. The Board will decide whether to hear the appeal based on the merits of the supporting material provided by the appellant.

While under appeal, the new standards will be used as the minimum requirements to be met by proponents or any other sources applying for approval. This will permit existing sources to meet CAP implementation deadlines and operating approval renewal deadlines. Where proponents are appealing a stringent emission limit regarding an existing source or members of the general public are appealing a limit they find too lenient for new or existing sources, an application may be made to the Minister for an extension to any such deadline until the Board has made its decision. New sources where the owner or operator has launched an appeal must either wait for the Board decision or proceed to meet the Ministry's proposed standards.

Once emission limits have been documented for a source proposal, they will be valid only for 12 months. Within this time proponents must design the proposed works and submit an application for approval of them. The emission limits will be imposed as conditions on the certificate of approval as enforceable emission rates to be demonstrated by source measurement, or detailed Standard Operating Procedures capable of audit for enforcement purposes.

If a certificate of approval to construct is issued (for new or modified sources), it will be valid only for 12-months from the date of issue; proponents must have commenced construction within that period. Failure to meet the 12-month deadlines noted here will mean that proponents will have to revise and resubmit the Technology Review or application for approval. [Additional details on the approvals process may be found in Appendix 4-1.]

In the course of the assessment of applications for approval, it may become clear that air quality considerations mandate controls superior to those based solely on the need to meet the emission limits. Such requirements arrived at in the approvals process take precedence; emission limits represent the *minimum* controls which may be expected of a source.

APPENDIX 7-4

REQUIREMENTS FOR UPSETS, START-UPS, SHUTDOWNS AND BYPASSES

APPENDIX 7-4

REQUIREMENTS FOR UPSETS, STARTUPS, SHUTDOWNS AND BYPASSES

The use of an air pollution control system implies a need to limit emissions which have some undesirable environmental effect. It is not acceptable to design such systems with inherently low reliability, nor to maintain them inadequately or operate them improperly. Failures that are a result of poor maintenance, careless operation or any other preventable upset condition, or preventable equipment breakdown shall not be considered malfunctions, and shall be considered in violation of the emission limits and ambient air standards. A malfunction is any sudden and unavoidable failure of air pollution control equipment, process equipment, or process to operate in a normal and usual manner which causes excess emissions. Increased emission rates from physical or operational modifications to any machine, equipment device, article or facility will not be permitted unless they are included as conditions on operating certificates of approval. However, it is recognized that emergencies can occur, even with systems which are designed, operated, and maintained well. These may involve failures of the control equipment, other malfunctions or threats to the survival of the control equipment. Under such emergency conditions, bypassing the control system for a limited period and thus discharging emissions to the atmosphere without control may be unavoidable.

As new and modified sources are evaluated for approvals purposes the impact of emissions during abnormal operation are to be addressed. The Ministry will allow the bypassing of emissions for emergency and malfunctions, but it will nonetheless be necessary to provide auxiliary control capability in the event of a bypass to ensure that the emissions during bypass always meet the regulatory limits as shown using the dispersion models. Furthermore, the installation and use of alternate control systems will be required to have a description of the corrective procedures that will be taken in the event of their malfunction or failure in order to achieve compliance with the regulation. The issue of required bypass frequency (i.e., control device or process reliability) will be important in establishing Level I, II, or III emission controls. The reliability of these auxiliary control systems will also have to be explicitly stated on the proposed operating certificates of approval. Even though excess emissions during periods of routine startup and shutdown of process equipment are not considered to be a malfunction any predictable shutdown or startup must also meet the air quality standard even if it also means putting in an auxiliary control program. Besides providing control systems on bypass operations it will be necessary to do everything possible to prevent the release of excess emissions into the atmosphere, such conditions to include the following changes in operating methods or procedures:

- 1) cessation of operation until the process equipment and/or air pollution control equipment is repaired. However, delay of repair of equipment for which leaks have been detected will be allowed until the end of the next process unit shutdown if the repair is technically infeasible without a process unit shutdown and it can be proven that greater emissions would result from the shutdown than from the delay in repair;

- 2) maintaining sufficient spare parts;
- 3) use of overtime labour;
- 4) use of outside consultants and contractors; and
- 5) other appropriate means.

When any emission source, air pollution control equipment, or related facility breaks down in such a manner as to cause the emission of air contaminants in excess of the applicable emission standards contained in this regulation, or of sufficient duration to cause damage to property or public health, the person responsible for such equipment shall promptly notify the Ministry and the Municipality of such failure or breakdown and provide a statement giving all pertinent facts. Those facilities with routine startup or shutdown will be exempt from this requirement if emissions do not exceed the ambient air quality standard and the schedule for such practice is on the operating C of A. Determining whether the ambient air standard is exceeded through source testing and modelling or by ambient air monitoring will be the responsibility of the proponent. In the case of shutdown of air pollution control equipment for necessary scheduled maintenance, the intent to shut down such equipment shall also be reported to the Ministry. In any case requiring the filing of a report, the Ministry requires the following:

- 1) the time and duration of the violation or the expected duration of the excess emission if the breakdown has not been fixed;
- 2) the name and location of the facility, operator and staff involved;
- 3) degree of bypass (100%-0%);
- 4) the reason for requiring bypassing;
- 5) identification of the equipment involved and the emission point or points (including bypass) from which the excess occurred or are occurring;
- 6) the efforts taken to minimize emissions and efforts to repair or otherwise bring the facility into compliance with the applicable emission limits or other equipment; and
- 7) identification of the air contaminant or contaminants and an estimate of the magnitude of excess emissions expressed in the units of the applicable emission limit for the air contaminant or contaminants of excess emission;

The filing of a report is required for all shutdowns, malfunctions and bypasses. This information must be routinely reported to the Ministry to ensure that the emission inventory reflects actual emissions in Ontario and to determine the reliability of control systems.

Prompt notification will be no later than 1 hour from the start of the malfunction and shall be provided by telephone to the Ministry's Spills Action Centre and the Ministry shall be notified when the condition causing the failure or breakdown has been corrected and the equipment is again in operation. A proponent will be required to submit a written statement of the causes and the action taken to prevent future similar upset or breakdown conditions within one month.

After the reporting of a shutdown/malfunction, if the Ministry determines that an upset condition is chronic and correctable by installing new or modified process or control procedures or equipment and/or has a history of excess emissions the proponent will be required to submit a malfunction abatement plan. The plan shall include a program and schedule to effectively eliminate the deficiencies causing the upset conditions. As a further requirement the owner or operator will be required to maintain logs to show that the operation and maintenance part of the malfunction abatement plan are implemented. Systems with inherently low reliability must be designed or redesigned with adequate redundancy to protect against excessive bypassing. Poor operating or maintenance practices need to be corrected and vigorously avoided.

The Ministry shall determine whether a violation of the EPA and its associated regulations has occurred based on the information submitted within the notification required and by any other means which the Ministry deems necessary, including but not limited to physical inspection of the facility by Ministry personnel and review of documentation pertaining to the maintenance and operation of process and air pollution control equipment. In doing so the Ministry will be assessing whether all practical steps have been taken to minimize the impact of the excess emissions on ambient air quality and whether the excess emissions are part of a recurring pattern indicative of inadequate design, operation, or maintenance.

APPENDIX 7-5

VISIBLE EMISSIONS

APPENDIX 7-5

VISIBLE EMISSIONS

In the Clean Air Program Discussion Paper published in November 1987, the Ministry proposed that the existing measures contained in O. Reg. 308 regulating visible emissions to the atmosphere (Sections 7 and 8) should be replaced by similar provisions to those used in the United States (Environmental Protection Agency Regulations on Standards of Performance for New Stationary Sources - Method 9). The EPA Method 9 (reproduced below) provides for the evaluation of visible emissions through the use of trained observers and accepted instrumental methods (Light Detection and Ranging (LIDAR)). The methodology for making acceptable observations is provided together with the requirements for qualifying observers and the specification for LIDAR measurements. It is proposed that Method 9 should be adopted with minor changes to comply with Ontario regulatory format and that the existing reference to "The Visible Emissions Chart of the Province of Ontario" should be deleted. The CAP regulation will permit enforcement action to be initiated by any adequately trained observer including both Ministry and non-Ministry staff.

Under the proposals, existing partial exemptions applying to visible emissions from the burning of solid fuels will be eliminated. Emissions caused through emergency venting systems will be subject to the proposed measures on upsets, shutdowns and bypasses contained in Appendix 7-4. The defence of due diligence will still be available in these circumstances and it is judged that this provides adequate protection for this type of situation.

The Ministry will require the use of opacity monitors where justified through continuous monitoring requirements. The conditions attached to continuous monitoring devices will apply to opacity monitors.

A number of non point sources of visible emissions including fire training and prescribed forestry burns will be subject to Codes of Practice as outlined in Appendix 5-2. Accordingly, these sources will be exempt from the general provisions of the CAP regulation concerning visible emissions and subject instead to the specific requirements associated with the appropriate code.

$$I = \frac{T_a V_{m(\text{out})} P_{\text{std}} 100}{T_{\text{std}} P_a A_n P_{\text{std}} (1 - B_{\text{out}})}$$

$$= K_a \frac{T_a V_{m(\text{out})}}{P_a P_{\text{std}} A_n (1 - B_{\text{out}})}$$

Equation 8-5

where:

$K_a = 4.320$ for metric units.
 $= 0.09450$ for English units

6.8 Acceptable Results. If 90 percent $< I < 110$ percent, the results are acceptable. If the results are low in comparison to the standards and I is beyond the acceptable range, the Administrator may opt to accept the results. Use Citation 4 in the Bibliography of Method 5 to make judgments. Otherwise, reject the results and repeat the test.

6.9 Stack Gas Velocity and Volumetric Flow Rate. Calculate the average stack gas velocity and volumetric flow rate, if needed, using data obtained in this method and equations in Sections 5.2 and 5.3 of Method 2.

7. Bibliography

1. Atmospheric Emissions from Sulfuric Acid Manufacturing Processes. U.S. DHEW, PHS, Division of Air Pollution, Public Health Service Publication No. 999-AP-13. Cincinnati, OH. 1965.
2. Corbett, P. F. The Determination of SO_x and SO₂ in Flue Gases. Journal of the Institute of Fuel. 24:237-243. 1961.
3. Martin, Robert M. Construction Details of Isokinetic Source Sampling Equipment. Environmental Protection Agency. Research Triangle Park, NC. Air Pollution Control Office Publication No. APTD-0581. April, 1971.
4. Patton, W. F. and J. A. Brink, Jr. New Equipment and Techniques for Sampling Chemical Process Gases. Journal of Air Pollution Control Association. 13:162. 1963.
5. Rom, J. J. Maintenance, Calibration, and Operation of Isokinetic Source-Sampling Equipment. Office of Air Programs, Environmental Protection Agency. Research Triangle Park, NC. APTD-0576. March, 1972.
6. Hamil, H. F. and D. E. Camann. Collaborative Study of Method for Determination of Sulfur Dioxide Emissions from Stationary Sources (Fossil Fuel-Fired Steam Generators). Environmental Protection Agency. Research Triangle Park, NC. EPA-650/4-74-024. December, 1973.
7. Annual Book of ASTM Standards. Part 31: Water, Atmospheric Analysis. pp. 40-42. American Society for Testing and Materials. Philadelphia, Pa. 1974.

METHOD 9—VISUAL DETERMINATION OF THE OPACITY OF EMISSIONS FROM STATIONARY SOURCES

Many stationary sources discharge visible emissions into the atmosphere; these emissions are usually in the shape of a plume. This method involves the determination of plume opacity by qualified observers. The method includes procedures for the training and certification of observers, and procedures to be used in the field for determination of plume opacity. The appearance of a plume as viewed by an observer depends upon a number of variables, some of which may be controllable and some of which may not be controllable in the field. Variables which can be controlled to an extent to which they no longer exert a significant influence upon plume appearance include: Angle of the observer with respect to the plume; angle of the observer with respect to the sun; point of observation of attached and detached steam plume; and angle of the observer with respect to a plume emitted from a rectangular stack with a large length to width ratio. The method includes specific criteria applicable to these variables.

Other variables which may not be controllable in the field are luminescence and color contrast between the plume and the background against which the plume is viewed. These variables exert an influence upon the appearance of a plume as viewed by an observer, and can affect the ability of the observer to accurately assign opacity values to the observed plume. Studies of the theory of plume opacity and field studies have demonstrated that a plume is most visible and presents the greatest apparent opacity when viewed against a contrasting background. It follows from this, and is confirmed by field trials, that the opacity of a plume, viewed under conditions where a contrasting background is present can be assigned with the greatest degree of accuracy. However, the potential for a positive error is also the greatest when a plume is viewed under such contrasting conditions. Under conditions presenting a less contrasting background, the apparent opacity of a plume is less and approaches zero as the color and luminescence contrast decrease toward zero. As a result, significant negative bias and negative errors can be made when a plume is viewed under less contrasting conditions. A negative bias decreases rather than increases the possibility that a plant operator will be cited for a violation of opacity standards due to observer error.

Studies have been undertaken to determine the magnitude of positive errors which can be made by qualified observers while reading plumes under contrasting conditions and using the procedures set forth in this method. The results of these studies

(field trials) which involve a total of 769 sets of 25 readings each are as follows:

(1) For black plumes (133 sets at a smoke generator), 100 percent of the sets were read with a positive error¹ of less than 7.5 percent opacity; 99 percent were read with a positive error of less than 5 percent opacity.

(2) For white plumes (170 sets at a smoke generator, 168 sets at a coal-fired power plant, 298 sets at a sulfuric acid plant), 99 percent of the sets were read with a positive error of less than 7.5 percent opacity; 95 percent were read with a positive error of less than 5 percent opacity.

The positive observational error associated with an average of twenty-five readings is therefore established. The accuracy of the method must be taken into account when determining possible violations of applicable opacity standards.

1. Principle and Applicability

1.1 Principle. The opacity of emissions from stationary sources is determined visually by a qualified observer.

1.2 Applicability. This method is applicable for the determination of the opacity of emissions from stationary sources pursuant to § 60.11(b) and for qualifying observers for visually determining opacity of emissions.

2. Procedures

The observer qualified in accordance with paragraph 3 of this method shall use the following procedures for visually determining the opacity of emissions:

2.1 Position. The qualified observer shall stand at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to his back. Consistent with maintaining the above requirement, the observer shall, as much as possible, make his observations from a position such that his line of vision is approximately perpendicular to the plume direction, and when observing opacity of emissions from rectangular outlets (e.g., roof monitors, open baghouses, noncircular stacks), approximately perpendicular to the longer axis of the outlet. The observer's line of sight should not include more than one plume at a time when multiple stacks are involved, and in any case the observer should make his observations with his line of sight perpendicular to the longer axis of such a set of multiple stacks (e.g., stub stacks on baghouses).

2.2 Field Records. The observer shall record the name of the plant, emission location, type facility, observer's name and affiliation, a sketch of the observer's position relative to the source, and the date on a

field data sheet (Figure 9-1). The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background are recorded on a field data sheet at the time opacity readings are initiated and completed.

2.3 Observations. Opacity observations shall be made at the point of greatest opacity in that portion of the plume where condensed water vapor is not present. The observer shall not look continuously at the plume, but instead shall observe the plume momentarily at 15-second intervals.

2.3.1 Attached Steam Plumes. When condensed water vapor is present within the plume as it emerges from the emission outlet, opacity observations shall be made beyond the point in the plume at which condensed water vapor is no longer visible. The observer shall record the approximate distance from the emission outlet to the point in the plume at which the observations are made.

2.3.2 Detached Steam Plume. When water vapor in the plume condenses and becomes visible at a distinct distance from the emission outlet, the opacity of emissions should be evaluated at the emission outlet prior to the condensation of water vapor and the formation of the steam plume.

2.4 Recording Observations. Opacity observations shall be recorded to the nearest 5 percent at 15-second intervals on an observational record sheet. (See Figure 9-2 for an example.) A minimum of 24 observations shall be recorded. Each momentary observation recorded shall be deemed to represent the average opacity of emissions for a 15-second period.

2.5 Data Reduction. Opacity shall be determined as an average of 24 consecutive observations recorded at 15-second intervals. Divide the observations recorded on the record sheet into sets of 24 consecutive observations. A set is composed of any 24 consecutive observations. Sets need not be consecutive in time and in no case shall two sets overlap. For each set of 24 observations, calculate the average by summing the opacity of the 24 observations and dividing this sum by 24. If an applicable standard specifies an averaging time requiring more than 24 observations, calculate the average for all observations made during the specified time period. Record the average opacity on a record sheet. (See Figure 9-1 for an example.)

3. Qualifications and Testing

3.1 Certification Requirements. To receive certification as a qualified observer, a candidate must be tested and demonstrate the ability to assign opacity readings in 5 percent increments to 25 different black

¹ For a set, positive error = average opacity determined by observers' 25 observations—average opacity determined from transmissometer's 25 recordings.

plumes and 25 different white plumes, with an error not to exceed 15 percent opacity on any one reading and an average error not to exceed 7.5 percent opacity in each category. Candidates shall be tested according to the procedures described in paragraph 3.2. Smoke generators used pursuant to paragraph 3.2 shall be equipped with a smoke meter which meets the requirements of paragraph 3.3.

The certification shall be valid for a period of 6 months, at which time the qualification procedure must be repeated by any observer in order to retain certification.

3.2 Certification Procedure. The certification test consists of showing the candidate a complete run of 50 plumes—25 black plumes and 25 white plumes—generated by a smoke generator. Plumes within each set of 25 black and 25 white runs shall be presented in random order. The candidate assigns an opacity value to each plume and records his observation on a suitable form. At the completion of each run of 50 readings, the score of the candidate is determined. If a candidate fails to qualify, the complete run of 50 readings must be repeated in any retest. The smoke test may be administered as part of a smoke school or training program, and may be preceded by training or familiarization runs of the smoke generator during which candidates are shown black and white plumes of known opacity.

3.3 Smoke Generator Specifications. Any smoke generator used for the purposes of paragraph 3.2 shall be equipped with a smoke meter installed to measure opacity across the diameter of the smoke generator stack. The smoke meter output shall display instack opacity based upon a pathlength equal to the stack exit diameter, on a full 0 to 100 percent chart recorder scale. The smoke meter optical design and performance shall meet the specifications shown in Table 9-1. The smoke meter shall be calibrated as prescribed in paragraph 3.3.1 prior to the conduct of each smoke reading test. At the completion of each test, the zero and span drift shall be checked and if the drift exceeds ± 1 percent opacity, the condition shall be corrected prior to conducting any subsequent test runs. The smoke meter shall be demonstrated, at the time of installation, to meet the specifications listed in

Table 9-1. This demonstration shall be repeated following any subsequent repair or replacement of the photocell or associated electronic circuitry including the chart recorder or output meter, or every 6 months, whichever occurs first.

TABLE 9-1—SMOKE METER DESIGN AND PERFORMANCE SPECIFICATIONS

Parameter	Specification
a. Light source.....	Incandescent lamp operated at nominal rated voltage.
b. Spectral response of photocell.....	Photopic (daylight spectral response of the human eye—reference 4.3).
c. Angle of view.....	15° maximum total angle.
d. Angle of projection	15° maximum total angle.
e. Calibration error	$\pm 3\%$ opacity, maximum.
f. Zero and span drift	$\pm 1\%$ opacity, 30 minutes
g. Response time	5 seconds.

3.3.1 Calibration. The smoke meter is calibrated after allowing a minimum of 30 minutes warmup by alternately producing simulated opacity of 0 percent and 100 percent. When stable response at 0 percent or 100 percent is noted, the smoke meter is adjusted to produce an output of 0 percent or 100 percent, as appropriate. This calibration shall be repeated until stable 0 percent and 100 percent readings are produced without adjustment. Simulated 0 percent and 100 percent opacity values may be produced by alternately switching the power to the light source on and off while the smoke generator is not producing smoke.

3.3.2 Smoke Meter Evaluation. The smoke meter design and performance are to be evaluated as follows:

3.3.2.1 Light Source. Verify from manufacturer's data and from voltage measurements made at the lamp, as installed, that the lamp is operated within ± 5 percent of the nominal rated voltage.

3.3.2.2 Spectral Response of Photocell. Verify from manufacturer's data that the photocell has a photopic response; i.e., the spectral sensitivity of the cell shall closely approximate the standard spectral-luminosity curve for photopic vision which is referenced in (b) of Table 9-1.

FIGURE 9-1
RECORD OF VISUAL DETERMINATION OF OPACITY

PAGE of

COMPANY _____
LOCATION _____
TEST NUMBER _____
DATE _____
TYPE FACILITY _____
CONTROL DEVICE _____

HOURS OF OBSERVATION _____
OBSERVER _____
OBSERVER CERTIFICATION DATE _____
OBSERVER AFFILIATION _____
POINT OF EMISSIONS _____
HEIGHT OF DISCHARGE POINT _____

CLOCK TIME
OBSERVER LOCATION
Distance to Discharge
Direction from Discharge
Height of Observation Point
BACKGROUND DESCRIPTION
WEATHER CONDITIONS
Wind Direction
Wind Speed
Ambient Temperature
SKY CONDITIONS (clear,
overcast, % clouds, etc.)
PLUME DESCRIPTION
Color
Distance Visible
OTHER INFORMATION

SUMMARY OF AVERAGE OPACITY

Readings ranged from _____ to _____ % opacity

The source was/was not in compliance with _____ at the time evaluation was made.

FIGURE 9-2—OBSERVATION RECORD

Page — of —

Company
Location
Test Number
Date

Observer
Type facility
Point of emissions

Hr.	Min.	Seconds				Steam plume (check if applicable)		Comments
		0	15	30	45	Attached	Detached	
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
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25								
26								
27								
28								
29								

FIGURE 9-2—OBSERVATION RECORD—(CONTINUED)

Page — of —

Company
 Location
 Test Number
 Date

Observer
 Type facility
 Point of emissions

Hr.	Min.	Seconds				Steam plume (check if applicable)		Comments
		0	15	30	45	Attached	Detached	
30								
31								
32								
33								
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3.3.2.3 Angle of View. Check construction geometry to ensure that the total angle of view of the smoke plume, as seen by the photocell, does not exceed 15°. The total

angle of view may be calculated from: $\theta = 2 \tan^{-1} d/2L$, where θ =total angle of view; d =the sum of the photocell diameter+the diameter of the limiting aperture; and

L=the distance from the photocell to the limiting aperture. The limiting aperture is the point in the path between the photocell and the smoke plume where the angle of view is most restricted. In smoke generator smoke meters this is normally an orifice plate.

3.3.2.4 Angle of Projection. Check construction geometry to ensure that the total angle of projection of the lamp on the smoke plume does not exceed 15°. The total angle of projection may be calculated from: $\theta = 2 \tan^{-1} d/2L$, where θ = total angle of projection; d = the sum of the length of the lamp filament + the diameter of the limiting aperture; and L = the distance from the lamp to the limiting aperture.

3.3.2.5 Calibration Error. Using neutral-density filters of known opacity, check the error between the actual response and the theoretical linear response of the smoke meter. This check is accomplished by first calibrating the smoke meter according to 3.3.1 and then inserting a series of three neutral-density filters of nominal opacity of 20, 50, and 75 percent in the smoke meter pathlength. Filters calibrated within ± 2 percent shall be used. Care should be taken when inserting the filters to prevent stray light from affecting the meter. Make a total of five nonconsecutive readings for each filter. The maximum error on any one reading shall be 3 percent opacity.

3.3.2.6 Zero and Span Drift. Determine the zero and span drift by calibrating and operating the smoke generator in a normal manner over a 1-hour period. The drift is measured by checking the zero and span at the end of this period.

3.3.2.7 Response Time. Determine the response time by producing the series of five simulated 0 percent and 100 percent opacity values and observing the time required to reach stable response. Opacity values of 0 percent and 100 percent may be simulated by alternately switching the power to the light source off and on while the smoke generator is not operating.

4. References.

4.1 Air Pollution Control District Rules and Regulations, Los Angeles County Air Pollution Control District, Regulation IV, Prohibitions, Rule 50.

4.2 Weisburd, Melvin I., Field Operations and Enforcement Manual for Air, U.S. Environmental Protection Agency, Research Triangle Park, NC. APTD-1100, August 1972, pp. 4.1-4.36.

4.3 Condon, E.U., and Odishaw, H., Handbook of Physics, McGraw-Hill Co., New York, NY, 1958, Table 3.1, p. 6-52.

ALTERNATE METHOD 1—DETERMINATION OF THE OPACITY OF EMISSIONS FROM STATIONARY SOURCES REMOTELY BY LIDAR

This alternate method provides the quantitative determination of the opacity of an emissions plume remotely by a mobile lidar system (laser radar; Light Detection and Ranging). The method includes procedures for the calibration of the lidar and procedures to be used in the field for the lidar determination of plume opacity. The lidar is used to measure plume opacity during either day or nighttime hours because it contains its own pulsed light source or transmitter. The operation of the lidar is not dependent upon ambient lighting conditions (light, dark, sunny or cloudy).

The lidar mechanism or technique is applicable to measuring plume opacity at numerous wavelengths of laser radiation. However, the performance evaluation and calibration test results given in support of this method apply only to a lidar that employs a ruby (red light) laser [Reference 5.1]:

1. Principle and Applicability

1.1 Principle. The opacity of visible emissions from stationary sources (stacks, roof vents, etc.) is measured remotely by a mobile lidar (laser radar).

1.2 Applicability. This method is applicable for the remote measurement of the opacity of visible emissions from stationary sources during both nighttime and daylight conditions, pursuant to 40 CFR § 60.11(b). It is also applicable for the calibration and performance verification of the mobile lidar for the measurement of the opacity of emissions. A performance/design specification for a basic lidar system is also incorporated into this method.

1.3 Definitions.

Azimuth angle: The angle in the horizontal plane that designates where the laser beam is pointed. It is measured from an arbitrary fixed reference line in that plane.

Backscatter: The scattering of laser light in a direction opposite to that of the incident laser beam due to reflection from particulates along the beam's atmospheric path which may include a smoke plume.

Backscatter signal: The general term for the lidar return signal which results from laser light being backscattered by atmospheric and smoke plume particulates.

Convergence distance: The distance from the lidar to the point of overlap of the lidar receiver's field-of-view and the laser beam.

Elevation angle: The angle of inclination of the laser beam referenced to the horizontal plane.

Far region: The region of the atmosphere's path along the lidar line-of-sight beyond or behind the plume being measured.

Lidar: Acronym for Light Detection and Ranging.

Lidar range: The range or distance from the lidar to a point of interest along the lidar line-of-sight.

Near region: The region of the atmospheric path along the lidar line-of-sight between the lidar's convergence distance and the plume being measured.

Opacity: One minus the optical transmittance of a smoke plume, screen target, etc.

Pick interval: The time or range intervals in the lidar backscatter signal whose minimum average amplitude is used to calculate opacity. Two pick intervals are required, one in the near region and one in the far region.

Plume: The plume being measured by lidar.

Plume signal: The backscatter signal resulting from the laser light pulse passing through a plume.

1/R² correction: The correction made for the systematic decrease in lidar backscatter signal amplitude with range.

Reference signal: The backscatter signal resulting from the laser light pulse passing through ambient air.

Sample interval: The time period between successive samples for a digital signal or between successive measurements for an analog signal.

Signal spike: An abrupt, momentary increase and decrease in signal amplitude.

Source: The source being tested by lidar.

Time reference: The time (t_0) when the laser pulse emerges from the laser, used as the reference in all lidar time or range measurements.

2. Procedures

The mobile lidar calibrated in accordance with Paragraph 3 of this method shall use the following procedures for remotely measuring the opacity of stationary source emissions:

2.1 Lidar Position. The lidar shall be positioned at a distance from the plume sufficient to provide an unobstructed view of the source emissions. The plume must be at a range of at least 50 meters or three consecutive pick intervals (whichever is greater) from the lidar's transmitter/receiver convergence distance along the line-of-sight. The maximum effective opacity measurement distance of the lidar is a function of local atmospheric conditions, laser beam diameter, and plume diameter. The test position of the lidar shall be selected so that the diameter of the laser beam at the measurement point within the plume shall be no larger than three-fourths the plume diameter. The beam diameter is calculated by Equation (AM1-1):

$$D(\text{lidar}) = A + R\phi < 0.75 D(\text{Plume}) \quad (\text{AM1-1})$$

Where:

$D(\text{Plume})$ = diameter of the plume (cm),

ϕ = laser beam divergence measured in radians

R = range from the lidar to the source (cm)

$D(\text{Lidar})$ = diameter of the laser beam at range R (cm),

A = diameter of the laser beam or pulse where it leaves the laser.

The lidar range, R , is obtained by aiming and firing the laser at the emissions source structure immediately below the outlet. The range value is then determined from the backscatter signal which consists of a signal spike (return from source structure) and the atmospheric backscatter signal [Reference 5.1]. This backscatter signal should be recorded.

When there is more than one source of emissions in the immediate vicinity of the plume, the lidar shall be positioned so that the laser beam passes through only a single plume, free from any interference of the other plumes for a minimum of 50 meters or three consecutive pick intervals (whichever is greater) in each region before and beyond the plume along the line-of-sight (determined from the backscatter signals). The lidar shall initially be positioned so that its line-of-sight is approximately perpendicular to the plume.

When measuring the opacity of emissions from rectangular outlets (e.g., roof monitors, open baghouses, noncircular stacks, etc.), the lidar shall be placed in a position so that its line-of-sight is approximately perpendicular to the longer (major) axis of the outlet.

2.2 Lidar Operational Restrictions. The lidar receiver shall not be aimed within an angle of $\pm 15^\circ$ (cone angle) of the sun.

This method shall not be used to make opacity measurements if thunderstorms, snowstorms, hail storms, high wind, high-ambient dust levels, fog or other atmospheric conditions cause the reference signals to consistently exceed the limits specified in Section 2.3.

2.3 Reference Signal Requirements. Once placed in its proper position for opacity measurement, the laser is aimed and fired with the line-of-sight near the outlet height and rotated horizontally to a position clear of the source structure and the associated plume. The backscatter signal obtained from this position is called the ambient-air or reference signal. The lidar operator shall inspect this signal [Section V of Reference 5.1] to: (1) determine if the lidar line-of-sight is free from interference from other plumes and from physical obstructions such as cables, power lines, etc., for a minimum of 50 meters or three consecutive pick intervals (whichever is greater) in each region before and beyond the plume, and (2) obtain a qualitative measure of the homogeneity of the ambient air by noting any signal spikes.

Should there be any signal spikes on the reference signal within a minimum of 50 meters or three consecutive pick intervals (whichever is greater) in each region before and beyond the plume, the laser shall be fired three more times and the operator shall inspect the reference signals on the display. If the spike(s) remains, the azimuth angle shall be changed and the above procedures conducted again. If the spike(s) disappears in all three reference signals, the lidar line-of-sight is acceptable if there is shot-to-shot consistency and there is no interference from other plumes.

Shot-to-shot consistency of a series of reference signals over a period of twenty seconds is verified in either of two ways. (1) The lidar operator shall observe the reference signal amplitudes. For shot-to-shot consistency the ratio of R_n to R_s [amplitudes of the near and far region pick intervals (Section 2.6.1)] shall vary by not more than $\pm 6\%$ between shots; or (2) the lidar operator shall accept any one of the reference signals and treat the other two as plume signals; then the opacity for each of the subsequent reference signals is calculated (Equation AM1-2). For shot-to-shot consistency, the opacity values shall be within $\pm 3\%$ of 0% opacity and the associated S_o values less than or equal to 8% (full scale) [Section 2.6].

If a set of reference signals fails to meet the requirements of this section, then all plume signals [Section 2.4] from the last set of acceptable reference signals to the failed set shall be discarded.

2.3.1 Initial and Final Reference Signals. Three reference signals shall be obtained within a 90-second time period prior to any data run. A final set of three reference signals shall be obtained within three (3) minutes after the completion of the same data run.

2.3.2 Temporal Criterion for Additional Reference Signals. An additional set of reference signals shall be obtained during a data run if there is a change in wind direction or plume drift of 30° or more from the direction that was prevalent when the last set of reference signals was obtained. An additional set of reference signals shall also be obtained if there is an increase in value of S_{n1} (near region standard deviation, Equation AM1-5) or S_{f1} (far region standard deviation, Equation AM1-6) that is greater than 8% (full scale) over the respective values calculated from the immediately previous plume signal, and this increase in value remains for 30 seconds or longer. An additional set of reference signals shall also be obtained if there is a change in amplitude in either the near or the far region of the plume signal, that is greater than 8% of the near signal amplitude and this change in amplitude remains for 30 seconds or more.

2.4 Plume Signal Requirements. Once properly aimed, the lidar is placed in operation with the nominal pulse or firing rate of six pulses/minute (1 pulse/10 seconds). The lidar operator shall observe the plume backscatter signals to determine the need for additional reference signals as required by Section 2.3.2. The plume signals are recorded from lidar start to stop and are called a data run. The length of a data run is determined by operator discretion. Short-term stops of the lidar to record additional reference signals do not constitute the end of a data run if plume signals are resumed within 90 seconds after the reference signals have been recorded, and the total stop or interrupt time does not exceed 3 minutes.

2.4.1 Non-hydrated Plumes. The laser shall be aimed at the region of the plume which displays the greatest opacity. The lidar operator must visually verify that the laser is aimed clearly above the source exit structure.

2.4.2 Hydrated Plumes. The lidar will be used to measure the opacity of hydrated or so-called steam plumes. As listed in the reference method, there are two types, i.e., attached and detached steam plumes.

2.4.2.1 Attached Steam Plumes. When condensed water vapor is present within a plume, lidar opacity measurements shall be made at a point within the residual plume where the condensed water vapor is no longer visible. The laser shall be aimed into the most dense region (region of highest opacity) of the residual plume.

During daylight hours the lidar operator locates the most dense portion of the residual plume visually. During nighttime hours a high-intensity spotlight, night vision scope, or low light level TV, etc., can be used as an aid to locate the residual plume. If visual determination is ineffective, the lidar may be used to locate the most dense region of the residual plume by repeatedly measuring opacity, along the longitudinal axis or center of the plume from the emissions outlet to a point just beyond the steam plume. The lidar operator should also observe color differences and plume reflectivity to ensure that the lidar is aimed completely within the residual plume. If the operator does not obtain a clear indication of the location of the residual plume, this method shall not be used.

Once the region of highest opacity of the residual plume has been located, aiming adjustments shall be made to the laser line-of-sight to correct for the following: movement to the region of highest opacity out of the lidar line-of-sight (away from the laser beam) for more than 15 seconds, expansion of the steam plume (air temperature lowers and/or relative humidity increases) so that it just begins to encroach on the field-of-view of the lidar's optical telescope receiver,

or a decrease in the size of the steam plume (air temperature higher and/or relative humidity decreases) so that regions within the residual plume whose opacity is higher than the one being monitored, are present.

2.4.2.2 Detached Steam Plumes. When the water vapor in a hydrated plume condenses and becomes visible at a finite distance from the stack or source emissions outlet, the opacity of the emissions shall be measured in the region of the plume clearly above the emissions outlet and below condensation of the water vapor.

During daylight hours the lidar operators can visually determine if the steam plume is detached from the stack outlet. During nighttime hours a high-intensity spotlight, night vision scope, low light level TV, etc., can be used as an aid in determining if the steam plume is detached. If visual determination is ineffective, the lidar may be used to determine if the steam plume is detached by repeatedly measuring plume opacity from the outlet to the steam plume along the plume's longitudinal axis or center line. The lidar operator should also observe color differences and plume reflectivity to detect a detached plume. If the operator does not obtain a clear indication of the location of the detached plume, this method shall not be used to make opacity measurements between the outlet and the detached plume.

Once the determination of a detached steam plume has been confirmed, the laser shall be aimed into the region of highest opacity in the plume between the outlet and the formation of the steam plume. Aiming adjustments shall be made to the lidar's line-of-sight within the plume to correct for

changes in the location of the most dense region of the plume due to changes in wind direction and speed or if the detached steam plume moves closer to the source outlet encroaching on the most dense region of the plume. If the detached steam plume should move too close to the source outlet for the lidar to make interference-free opacity measurements, this method shall not be used.

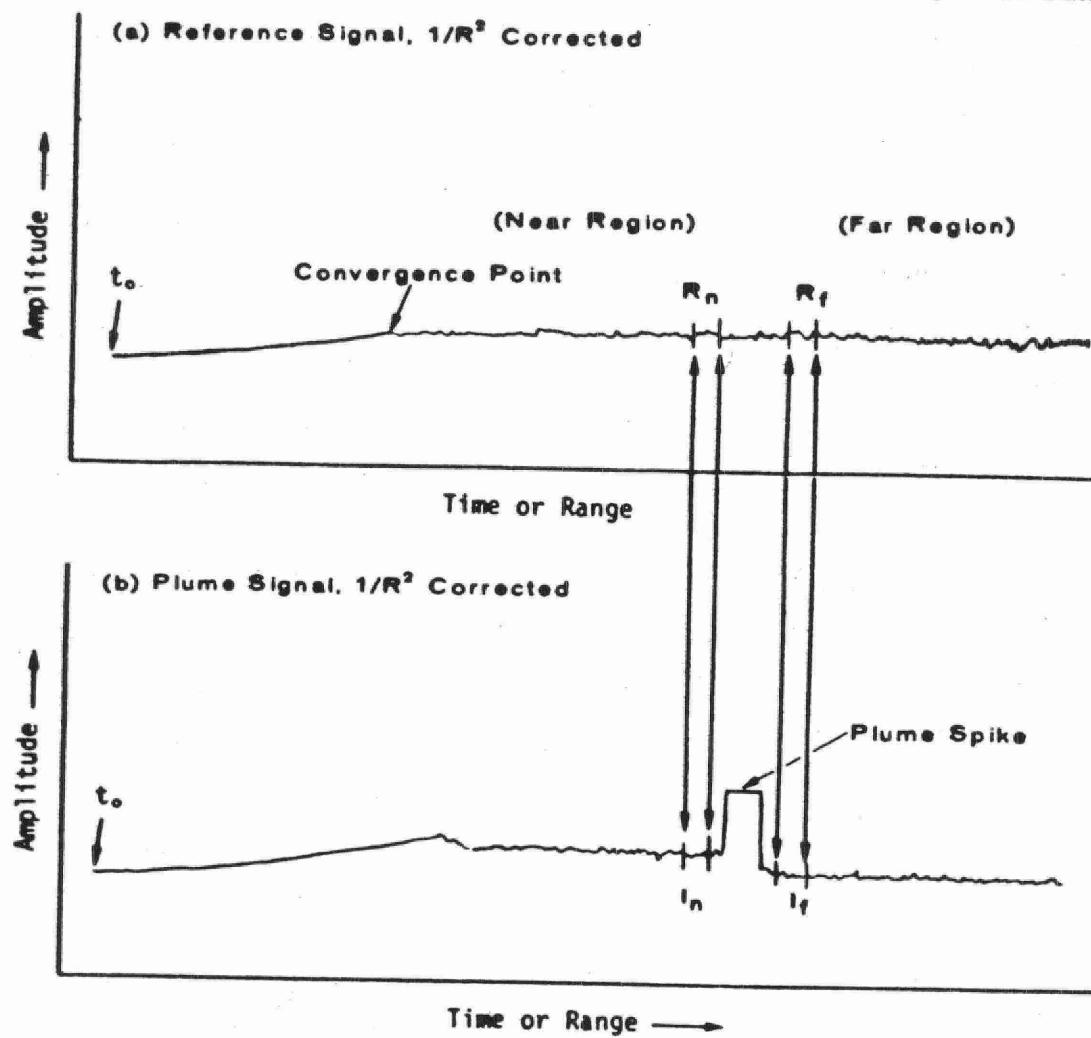
2.5 Field Records. In addition to the recording recommendations listed in other sections of this method the following records should be maintained. Each plume measured should be uniquely identified. The name of the facility, type of facility, emission source type, geographic location of the lidar with respect to the plume, and plume characteristics should be recorded. The date of the test, the time period that a source was monitored, the time (to the nearest second) of each opacity measurement, and the sample interval should also be recorded. The wind speed, wind direction, air temperature, relative humidity, visibility (measured at the lidar's position), and cloud cover should be recorded at the beginning and end of each time period for a given source. A small sketch depicting the location of the laser beam within the plume should be recorded.

If a detached or attached steam plume is present at the emissions source, this fact should be recorded. Figures AM1-I and AM1-II are examples of logbook forms that may be used to record this type of data. Magnetic tape or paper tape may also be used to record data.

Figure AM1-1 Lidar Log Control Number Tabulation

LIDAR LOG OF OPERATIONS		LIDAR OPERATOR'S NOTES
Control number: 09161		(Indicate position of laser beam within plane-- reflected plane, etc.)
Facility name and location:		
At the field site on / / from _____ to _____ (local time)		
Location of LIDAR:		
Direction to source _____ Range to source _____ to _____		
Laser elevation (+ angle is up, horizontal is 0°) _____		
Source type and official designation:		
Plane characteristics (color, shape, streak present, etc.)		
Wind speed: begin _____ km/hr end _____ km/hr Wind direction: begin _____ end _____		
Air temperature: begin _____ °C end _____ °C Relative humidity: begin _____ % end _____ %		
Barometric: begin _____ end _____ Visibility: begin _____ km end _____ km		
Cloud cover: begin _____ end _____		
Data records made in field (tapes, printsheets, photo's, etc.):		
MAGNETIC TAPES <input type="checkbox"/> tapes <input type="checkbox"/> tracks <input type="checkbox"/> files		
OPERATOR'S SIGNATURE: _____ DATE: _____ WITNESS SIGNATURE: _____ DATE: _____		
LIDAR FUNCTION VERIFICATION Date of last calibration _____ Source: optical generator () screens () This test recorded on tape # _____ tracks # _____ Calibrated opacity _____ Calculated opacity _____ Recorded on file _____ OPERATOR'S SIGNATURE: _____ DATE: _____ WITNESS SIGNATURE: _____ DATE: _____		

Figure AM1-II Lidar Log Of Operations



- (a) Reference signal, $1/R^2$ -corrected. This reference signal is for plume signal (b). R_n , R_f are chosen to coincide with I_n , I_f .
- (b) Plume signal, $1/R^2$ -corrected. The plume spike and the decrease in the backscatter signal amplitude in the far region are due to the opacity of the plume. I_n , I_f are chosen as indicated in Section 2.6.

Figure AMI-III. Plots of Lidar Backscatter Signals

2.6 Opacity Calculation and Data Analysis. Referring to the reference signal and plume signal in Figure AM1-III, the measured opacity (O_p) in percent for each lidar

measurement is calculated using Equation AM1-2. ($O_p = 1 - T_p$; T_p is the plume transmittance.)

$$O_p = (100\%) \left[1 - \left(\frac{I_f}{R_f} \frac{R_n}{I_n} \right)^{\frac{1}{2}} \right], \quad (\text{AM1-2})$$

Where:

I_n =near-region pick interval signal amplitude, plume signal, $1/R^2$ corrected,

I_f =far-region pick interval signal amplitude, plume signal, $1/R^2$ corrected,

R_n =near-region pick interval signal amplitude, reference signal, $1/R^2$ corrected, and

R_f =far-region pick interval signal amplitude, reference signal, $1/R^2$ corrected.

The $1/R^2$ correction to the plume and reference signal amplitudes is made by multiplying the amplitude for each successive sample interval from the time reference, by the square of the lidar time (or range) associated with that sample interval [Reference 5.1].

The first step in selecting the pick intervals for Equation AM1-2 is to divide the plume signal amplitude by the reference signal amplitude at the same respective ranges to obtain a "normalized" signal. The pick intervals selected using this normalized signal, are a minimum of 15 m (100 nanoseconds) in length and consist of at least 5 contiguous sample intervals. In addition, the following criteria, listed in order of importance, govern pick interval selection. (1) The intervals shall be in a region of the normalized signal where the reference signal meets the requirements of Section 2.3 and is everywhere greater than zero. (2) The intervals (near and far) with the minimum average amplitude are chosen. (3) If more than one interval with the same minimum average amplitude is found, the interval closest to the plume is chosen. (4) The standard deviation, S_o , for the calculated opacity shall be 8% or less. (S_o is calculated by Equation AM1-7).

If S_o is greater than 8%, then the far pick interval shall be changed to the next interval of minimal average amplitude. If S_o is still greater than 8%, then this procedure is repeated for the far pick interval. This procedure may be repeated once again for the near pick interval, but if S_o remains greater than 8%, the plume signal shall be discarded.

The reference signal pick intervals, R_n and R_f , must be chosen over the same time interval as the plume signal pick intervals, I_n and I_f , respectively [Figure AM1-III]. Other methods of selecting pick intervals may be used if they give equivalent results. Field-oriented examples of pick interval selection are available in Reference 5.1.

The average amplitudes for each of the pick intervals, I_n , I_f , R_n , R_f , shall be calculated by averaging the respective individual amplitudes of the sample intervals from the plume signal and the associated reference signal each corrected for $1/R^2$. The amplitude of I_n shall be calculated according to Equation (AM1-3).

$$I_n = \frac{1}{m} \sum_{i=1}^m I_{ni}, \quad (\text{AM1-3})$$

Where:

I_{ni} =the amplitude of the ith sample interval (near-region),

Σ =sum of the individual amplitudes for the sample intervals,

m =number of sample intervals in the pick interval, and

I_n =average amplitude of the near-region pick interval.

Similarly, the amplitudes for I_f , R_n , and R_f are calculated with the three expressions in Equation (AM1-4).

$$I_f = \frac{1}{m} \sum_{i=1}^m I_{fi}, \quad R_n = \frac{1}{m} \sum_{i=1}^m R_{ni}, \quad R_f = \frac{1}{m} \sum_{i=1}^m R_{fi}. \quad (\text{AM1-4})$$

The standard deviation, S_{In} , of the set of amplitudes for the near-region pick interval, I_n , shall be calculated using Equation (AM1-5).

$$S_{In} = \left[\frac{1}{m-1} \sum_{i=1}^m \left(\frac{I_{ni} - I_n}{m-1} \right)^2 \right]^{\frac{1}{2}}. \quad (\text{AM1-5})$$

Similarly, the standard deviations S_{If} , S_{Rn} , and S_{Rf} are calculated with the three expressions in Equation (AM1-6).

$$S_{If} = \left[\frac{1}{m-1} \sum_{i=1}^m \left(\frac{I_{fi} - I_f}{m-1} \right)^2 \right]^{\frac{1}{2}},$$

$$S_{Rn} = \left[\frac{1}{m-1} \sum_{i=1}^m \left(\frac{R_{ni} - R_n}{m-1} \right)^2 \right]^{\frac{1}{2}},$$

$$S_{Rf} = \left[\frac{1}{m-1} \sum_{i=1}^m \left(\frac{R_{fi} - R_f}{m-1} \right)^2 \right]^{\frac{1}{2}}.$$

(AM1-6)

The standard deviation, S_o , for each associated opacity value, O_p , shall be calculated using Equation (AM1-7).

$$S_o = \frac{(100\%)}{2} \left(\frac{I_f R_n}{R_f I_n} \right)^{\frac{1}{2}} \left[\frac{S_{In}^2}{I_n^2} + \frac{S_{If}^2}{I_f^2} + \frac{S_{Rn}^2}{R_n^2} + \frac{S_{Rf}^2}{R_f^2} \right]^{\frac{1}{2}} \quad (\text{AM1-7})$$

The calculated values of I_n , I_f , R_n , R_f , S_{In} , S_{If} , S_{Rn} , O_p , and S_o should be recorded. Any plume signal with an S_o greater than 8% shall be discarded.

2.6.1 Azimuth Angle Correction. If the azimuth angle correction to opacity specified in this section is performed, then the elevation angle correction specified in Section 2.6.2 shall not be performed. When

opacity is measured in the residual region of an attached steam plume, and the lidar line-of-sight is not perpendicular to the plume, it may be necessary to correct the opacity measured by the lidar to obtain the opacity that would be measured on a path perpendicular to the plume. The following method, or any other method which produces equivalent results, shall be used to determine the

need for a correction, to calculate the correction, and to document the point within the plume at which the opacity was measured.

Figure AM1-IV(b) shows the geometry of the opacity correction. L' is the path through the plume along which the opacity measurement is made. P' is the path perpen-

dicular to the plume at the same point. The angle ϵ is the angle between L' and the plume center line. The angle $(\pi/2 - \epsilon)$, is the angle between the L' and P' . The measured opacity, O_p , measured along the path L' shall be corrected to obtain the corrected opacity, O_{pc} , for the path P' , using Equation (AM1-8).

$$\begin{aligned} O_{pc} &= (100\%) \left[1 - (1 - 0.01 O_p)^{\cos(\pi/2 - \epsilon)} \right] \\ &= (100\%) \left[1 - (1 - 0.01 O_p)^{\sin \epsilon} \right] \quad (\text{AM1-8}) \end{aligned}$$

The correction in Equation (AM1-8) shall be performed if the inequality in Equation (AM1-9) is true.

$$\epsilon \geq \sin^{-1} \left[\frac{\ln(101 - O_p)}{\ln(100 - O_p)} \right] \quad (\text{AM1-9})$$

Figure AM1-IV(a) shows the geometry used to calculate ϵ and the position in the plume at which the lidar measurement is made. This analysis assumes that for a given lidar measurement, the range from

the lidar to the plume, the elevation angle of the lidar from the horizontal plane, and the azimuth angle of the lidar from an arbitrary fixed reference in the horizontal plane can all be obtained directly.

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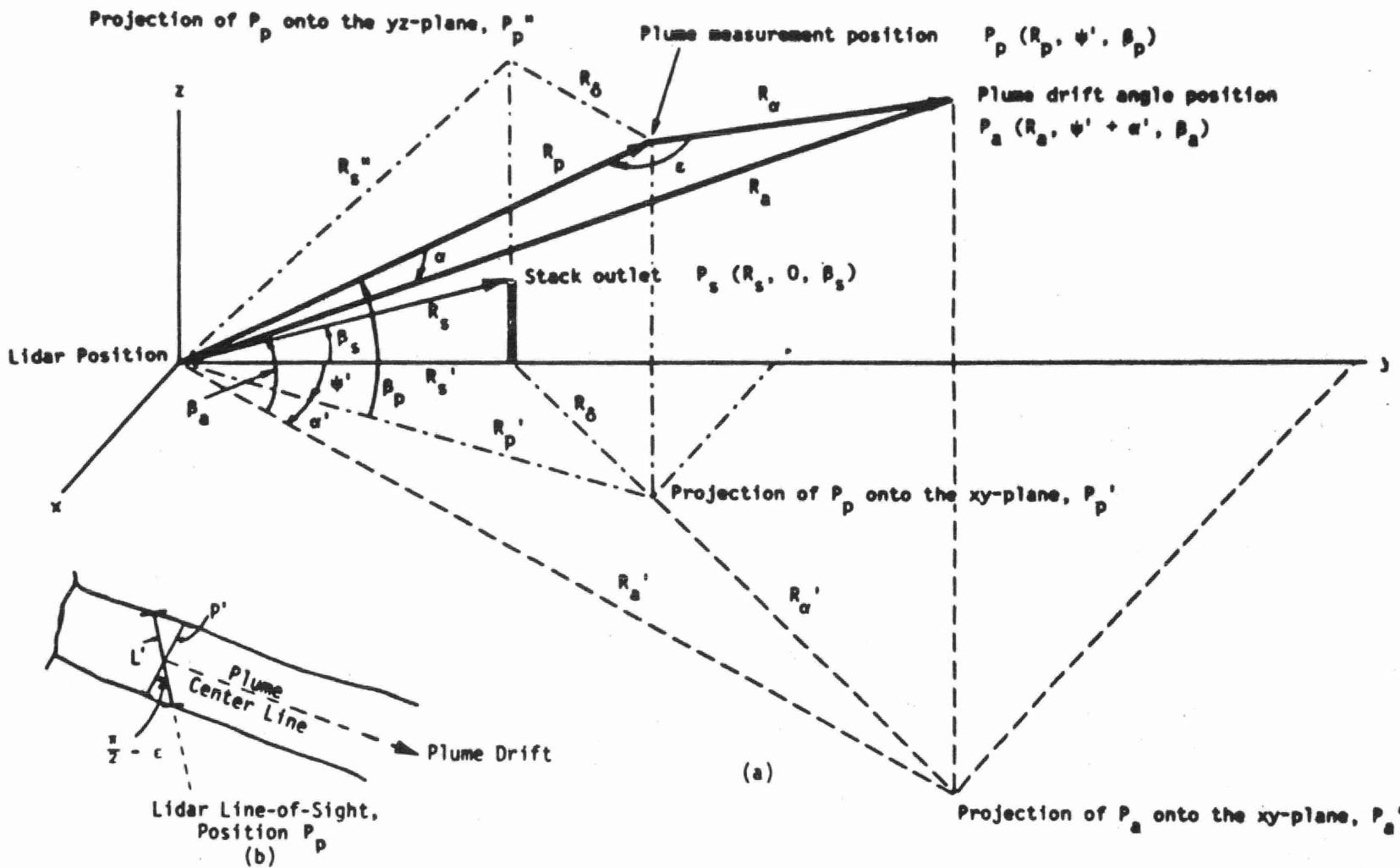


Figure AMI - IV. Correction in Opacity for Drift of the Residual Region of an Attached Steam Plume.

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R_s =range from lidar to source*

β_s =elevation angle of R_s *

R_p =range from lidar to plume at the opacity measurement point*

β_p =elevation angle of R_p *

R_e =range from lidar to plume at some arbitrary point, P_e , so the drift angle of the plume can be determined*

β_e =elevation angle of R_e *

α =angle between R_s and R_e

R'_s =projection of R_s in the horizontal plane

R'_p =projection of R_p in the horizontal plane

R'_e =projection of R_e in the horizontal plane

ψ =angle between R'_s and R'_e *

α' =angle between R'_s and R'_p *

$R \leq$ =distance from the source to the opacity measurement point projected in the horizontal plane

$R\theta$ =distance from opacity measurement point P_e to the point in the plume P_e .

$$O_{pc} = 1 - (1 - O_p) \cos(\pi/2 - \epsilon) = 1 - (1 - O_p) \sin \epsilon \quad (\text{AM1-8})$$

The correction angle ϵ shall be determined using Equation AM1-10.

Where:

$\alpha = \cos^{-1}(\cos \beta_s, \cos \beta_p, \cos \alpha, \sin \beta_s, \sin \beta_p)$, and

$$R\theta = (R_p^2 + R_s^2 - 2 R_p R_s \cos \alpha)^{1/2}$$

$R \leq$, the distance from the source to the opacity measurement point projected in the horizontal plane, shall be determined using Equation AM1-11.

$$R_\delta = (R_s^2 + R_p^2 - 2 R_s R_p \cos \psi')^{1/2}, \quad (\text{AM1-11})$$

Where:

$R'_s = R_s \cos \beta_s$, and

$R'_p = R_p \cos \beta_p$.

In the special case where the plume centerline at the opacity measurement point is

horizontal, parallel to the ground, Equation AM1-12 may be used to determine ϵ instead of Equation AM1-10.

$$\epsilon = \cos^{-1} \left[\frac{R_p^2 + R_\delta^2 - R_s^2}{2 R_p R_\delta} \right] \quad (\text{AM1-12})$$

Where:

$$R'' = (R'^2 + R_p^2 \sin^2 \beta_p)^{1/2}$$

If the angle ϵ is such that $\epsilon < 30^\circ$ or $\epsilon > 150^\circ$, the azimuth angle correction shall not be performed and the associated opacity value shall be discarded.

2.6.2 Elevation Angle Correction. An individual lidar-measured opacity, O_p , shall be corrected for elevation angle if the laser elevation or inclination angle, β , [Figure AM1-V], is greater than or equal to the value calculated in Equation AM1-13.

*Obtained directly from lidar. These values should be recorded.

$$\beta_p \geq \cos^{-1} \left[\frac{\ln(101 - O_p)}{\ln(100 - O_p)} \right] \quad (\text{AM1-13})$$

The measured opacity, O_p , along the lidar path L, is adjusted to obtain the corrected opacity, O_{pc} , for the actual plume (horizontal) path, P, by using Equation (AM1-14).

$$O_{pc} = (100\%) \left[1 - (1 - 0.01 O_p)^{\cos \beta_p} \right], \quad (\text{AM1-14})$$

Where:

β_p =lidar elevation or inclination angle,
 O_p =measured opacity along path L, and

O_{pc} =corrected opacity for the actual plume thickness P.

The values for β_p , O_p , and O_{pc} should be recorded.

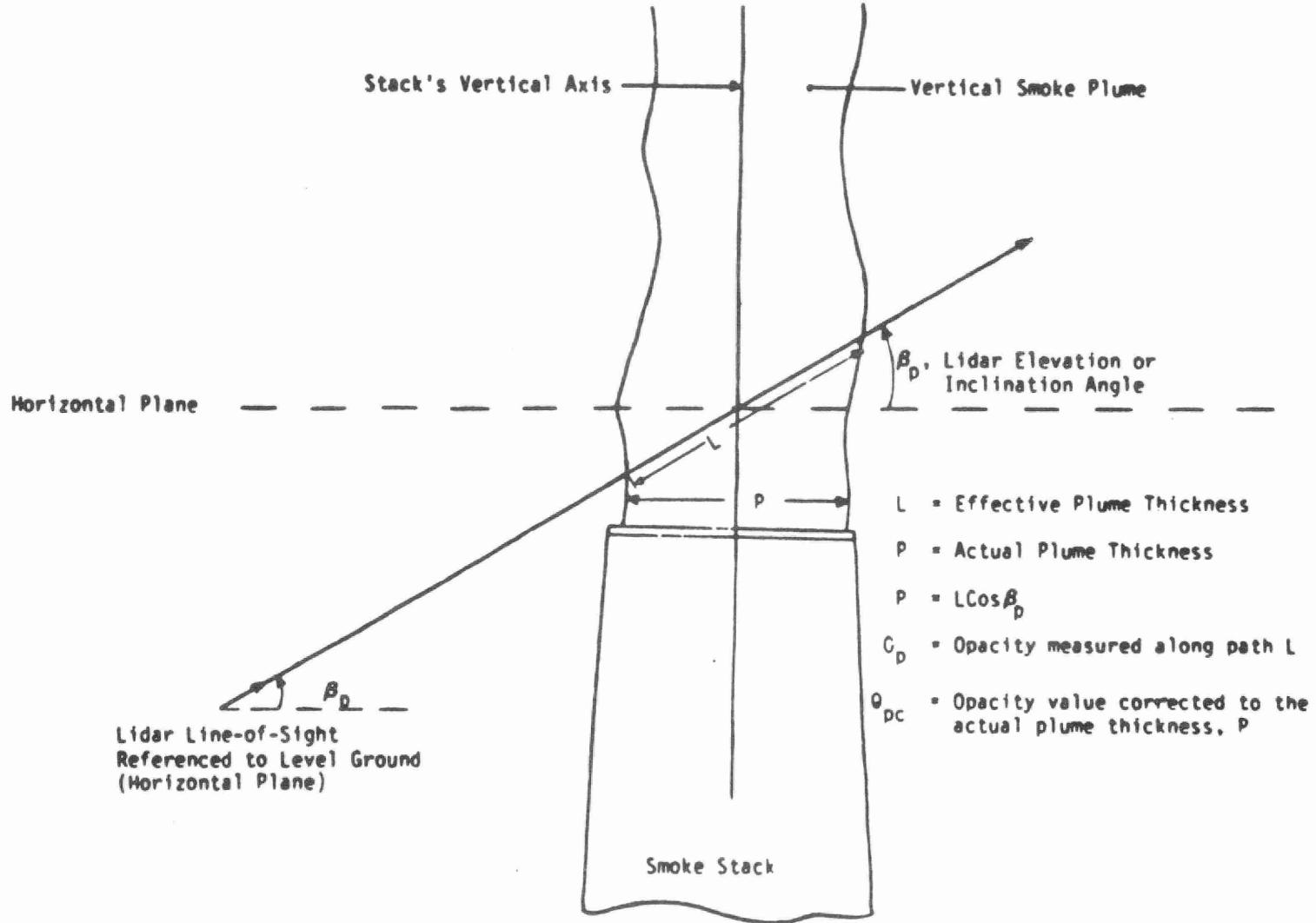


Figure AMI-V. Elevation Angle Correction for Vertical Plumes.

2.6.3 Determination of Actual Plume Opacity. Actual opacity of the plume shall be determined by Equation AM1-15.

$$O_{pa} = O_{pc} - [2 S_0 + 5\%]. \quad (AM1-15)$$

2.6.4 Calculation of Average Actual Plume Opacity. The average of the actual plume opacity, \bar{O}_{pa} , shall be calculated as the average of the consecutive individual actual opacity values, O_{pa} , by Equation AM1-16.

$$\bar{O}_{pa} = \frac{1}{n} \sum_{k=1}^n (O_{pa})_k. \quad (AM1-16)$$

Where:

$(O_{pa})_k$ =the kth actual opacity value in an averaging interval containing n opacity values; k is a summing index.

Σ =the sum of the individual actual opacity values.

n=the number of individual actual opacity values contained in the averaging interval.

\bar{O}_{pa} =average actual opacity calculated over the averaging interval.

3. Lidar Performance Verification

The lidar shall be subjected to two types of performance verifications that shall be performed in the field. The annual calibration, conducted at least once a year, shall be used to directly verify operation and performance of the entire lidar system. The routine verification, conducted for each emission source measured, shall be used to insure proper performance of the optical receiver and associated electronics.

3.1 Annual Calibration Procedures. Either a plume from a smoke generator or screen targets shall be used to conduct this calibration.

If the screen target method is selected, five screens shall be fabricated by placing an opaque mesh material over a narrow frame (wood, metal extrusion, etc.). The screen shall have a surface area of at least one square meter. The screen material should be chosen for precise optical opacities of about 10, 20, 40, 60, and 80%. Opacity of each target shall be optically determined and should be recorded. If a smoke generator plume is selected, it shall meet the requirements of Section 3.3 of Reference Method 9. This calibration shall be performed in the field during calm (as practical) atmospheric conditions. The lidar shall be positioned in accordance with Section 2.1.

The screen targets must be placed perpendicular to and coincident with the lidar line-of-sight at sufficient height above the ground (suggest about 30 ft) to avoid ground-level dust contamination. Reference signals shall be obtained just prior to conducting the calibration test.

The lidar shall be aimed through the center of the plume within 1 stack diameter of the exit, or through the geometric center of the screen target selected. The lidar shall be set in operation for a 6-minute data run at a nominal pulse rate of 1 pulse every 10 seconds. Each backscatter return signal and each respective opacity value obtained from the smoke generator transmissometer, shall be obtained in temporal coincidence. The data shall be analyzed and reduced in accordance with Section 2.6 of this method. This calibration shall be performed for 0% (clean air), and at least five other opacities (nominally 10, 20, 40, 60, and 80%).

The average of the lidar opacity values obtained during a 6-minute calibration run shall be calculated and should be recorded. Also the average of the opacity values obtained from the smoke generator transmissometer for the same 6-minute run shall be calculated and should be recorded.

Alternate calibration procedures that do not meet the above requirements but produce equivalent results may be used.

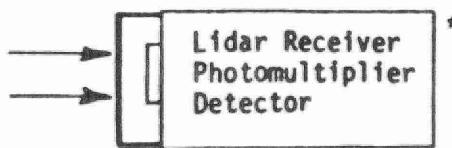
3.2 Routine Verification Procedures. Either one of two techniques shall be used to conduct this verification. It shall be performed at least once every 4 hours for each emission source measured. The following parameters shall be directly verified.

1) The opacity value of 0% plus a minimum of 5 (nominally 10, 20, 40, 60, and 80%) opacity values shall be verified through the PMT detector and data processing electronics.

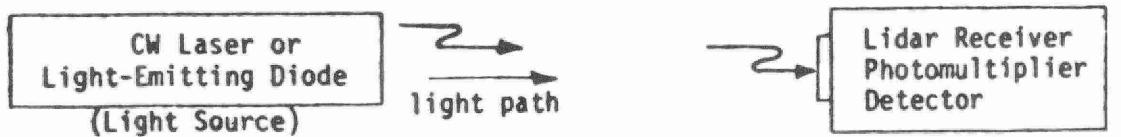
2) The zero-signal level (receiver signal with no optical signal from the source present) shall be inspected to insure that no spurious noise is present in the signal. With the entire lidar receiver and analog/digital electronics turned on and adjusted for normal operating performance, the following procedures shall be used for Techniques 1 and 2, respectively.

3.2.1 Procedure for Technique 1. This test shall be performed with no ambient or stray light reaching the PMT detector. The narrow band filter (694.3 nanometers peak) shall be removed from its position in front of the PMT detector. Neutral density filters of nominal opacities of 10, 20, 40, 60, and 80% shall be used. The recommended test configuration is depicted in Figure AM1-VI.

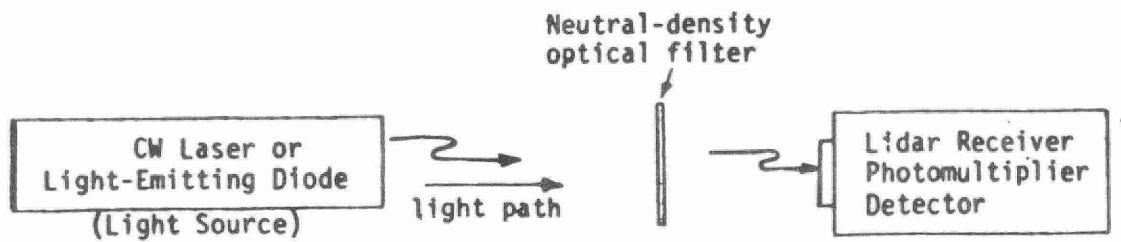
PMT Entrance
Window Completely
Covered



(a) Zero-Signal Level Test



(b) Clear-Air or 0% Opacity Test



(c) Optical Filter Test (simulated opacity values)

*Tests shall be performed with no ambient or stray light reaching the detector.

Figure AMI-VI. Test Configuration for Technique 1.

The zero-signal level shall be measured and should be recorded, as indicated in Figure AM1-VI(a). This simulated clear-air or 0% opacity value shall be tested in using the selected light source depicted in Figure AM1-VI(b).

The light source either shall be a continuous wave (CW) laser with the beam mechanically chopped or a light emitting diode controlled with a pulse generator (rectangular pulse). (A laser beam may have to be attenuated so as not to saturate the PMT detector). This signal level shall be measured and should be recorded. The opacity value is calculated by taking two pick intervals [Section 2.6] about 1 microsecond apart in time and using Equation (AM1-2) setting the ratio $R_a/R_t=1$. This calculated value should be recorded.

The simulated clear-air signal level is also employed in the optical test using the neutral density filters. Using the test configuration in Figure AM1-VI(c), each neutral density filter shall be separately placed into the light path from the light source to the PMT detector. The signal level shall be measured and should be recorded. The opacity value for each filter is calculated by taking the signal level for that respective filter (I_t), dividing it by the 0% opacity signal level (I_a) and performing the remainder of the calculation by Equation (AM1-2) with $R_a/R_t=1$. The calculated opacity value for each filter should be recorded.

The neutral density filters used for Technique 1 shall be calibrated for actual opacity with accuracy of $\pm 2\%$ or better. This calibration shall be done monthly while the filters are in use and the calibrated values should be recorded.

3.2.2 Procedure for Technique 2. An optical generator (built-in calibration mechanism) that contains a light-emitting diode (red light for a lidar containing a ruby laser) is used. By injecting an optical signal into the lidar receiver immediately ahead of the PMT detector, a backscatter signal is simulated. With the entire lidar receiver electronics turned on and adjusted for normal operating performance, the optical generator is turned on and the simulation signal (corrected for $1/R^2$) is selected with no plume spike signal and with the opacity value equal to 0%. This simulated clear-air atmospheric return signal is displayed on the system's video display. The lidar operator then makes any fine adjustments that

may be necessary to maintain the system's normal operating range.

The opacity values of 0% and the other five values are selected one at a time in any order. The simulated return signal data should be recorded. The opacity value shall be calculated. This measurement/calculation shall be performed at least three times for each selected opacity value. While the order is not important, each of the opacity values from the optical generator shall be verified. The calibrated optical generator opacity value for each selection should be recorded.

The optical generator used for Technique 2 shall be calibrated for actual opacity with an accuracy of $\pm 1\%$ or better. This calibration shall be done monthly while the generator is in use and calibrated value should be recorded.

Alternate verification procedures that do not meet the above requirements but produce equivalent results may be used.

3.3 Deviation. The permissible error for the annual calibration and routine verification are:

3.3.1 Annual Calibration Deviation.

3.3.1.1 Smoke Generator. If the lidar-measured average opacity for each data run is not within $\pm 5\%$ (full scale) of the respective smoke generator's average opacity over the range of 0% through 80%, then the lidar shall be considered out of calibration.

3.3.1.2 Screens. If the lidar-measured average opacity for each data run is not within $\pm 3\%$ (full scale) of the laboratory-determined opacity for each respective simulation screen target over the range of 0% through 80%, then the lidar shall be considered out of calibration.

3.3.2 Routine Verification Error. If the lidar-measured average opacity for each neutral density filter (Technique 1) or optical generator selection (Technique 2) is not within $\pm 3\%$ (full scale) of the respective laboratory calibration value then the lidar shall be considered non-operational.

4. Performance/Design Specification for Basic Lidar System

4.1 Lidar Design Specification. The essential components of the basic lidar system are a pulsed laser (transmitter), optical receiver, detector, signal processor, recorder, and an aiming device that is used in aiming the lidar transmitter and receiver. Figure AM1-VII shows a functional block diagram of a basic lidar system.

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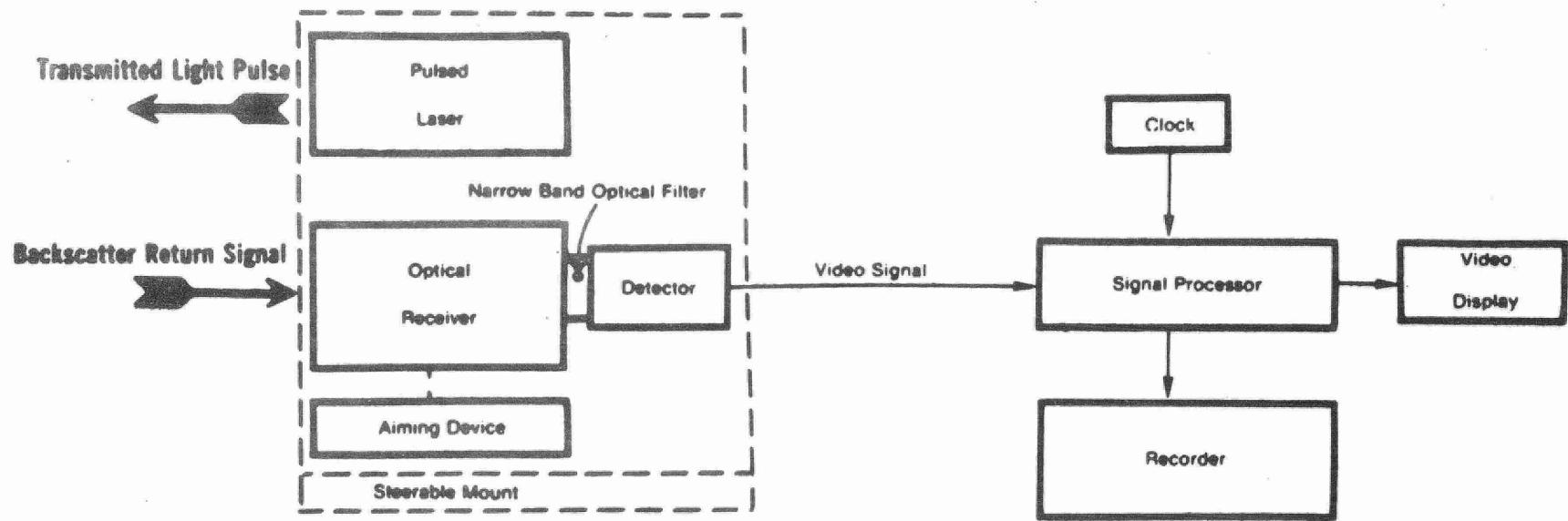


Figure AM1-VH. Functional Block Diagram of a Basic Lidar System

4.2 Performance Evaluation Tests. The owner of a lidar system shall subject such a lidar system to the performance verification tests described in Section 3, prior to first use of this method. The annual calibration shall be performed for three separate, complete runs and the results of each should be recorded. The requirements of Section 3.3.1 must be fulfilled for each of the three runs.

Once the conditions of the annual calibration are fulfilled the lidar shall be subjected to the routine verification for three separate complete runs. The requirements of Section 3.3.2 must be fulfilled for each of the three runs and the results should be recorded. The Administrator may request that the results of the performance evaluation be submitted for review.

5. References

5.1 The Use of Lidar for Emissions Source Opacity Determination, U.S. Environmental Protection Agency, National Enforcement Investigations Center, Denver, CO. EPA-330/1-79-003-R, Arthur W. Dybdahl, current edition [NTIS No. PB81-246662].

5.2 Field Evaluation of Mobile Lidar for the Measurement of Smoke Plume Opacity, U.S. Environmental Protection Agency, National Enforcement Investigations Center, Denver, CO. EPA/NEIC-TS-128, February 1978.

5.3 Remote Measurement of Smoke Plume Transmittance Using Lidar, C. S. Cook, G. W. Bethke, W. D. Conner (EPA/RTP). Applied Optics 11, pg 1742. August 1972.

5.4 Lidar Studies of Stack Plumes in Rural and Urban Environments, EPA-650/4-73-002, October 1973.

5.5 American National Standard for the Safe Use of Lasers ANSI Z 136.1-176, March 8, 1976.

5.6 U.S. Army Technical Manual TB MED 279, Control of Hazards to Health from Laser Radiation, February 1969.

5.7 Laser Institute of America Laser Safety Manual, 4th Edition.

5.8 U.S. Department of Health, Education and Welfare, Regulations for the Administration and Enforcement of the Radiation Control for Health and Safety Act of 1968, January 1976.

5.9 Laser Safety Handbook, Alex Mallow, Leon Chabot, Van Nostrand Reinhold Co., 1978.

METHOD 10—DETERMINATION OF CARBON MONOXIDE EMISSIONS FROM STATIONARY SOURCES

1. Principle and Applicability

1.1 Principle. An integrated or continuous gas sample is extracted from a sampling point and analyzed for carbon monoxide

(CO) content using a Luft-type nondispersive infrared analyzer (NDIR) or equivalent.

1.2 Applicability. This method is applicable for the determination of carbon monoxide emissions from stationary sources only when specified by the test procedures for determining compliance with new source performance standards. The test procedure will indicate whether a continuous or an integrated sample is to be used.

2. Range and Sensitivity

2.1 Range. 0 to 1,000 ppm.

2.2 Sensitivity. Minimum detectable concentration is 20 ppm for a 0 to 1,000 ppm span.

3. Interferences

Any substance having a strong absorption of infrared energy will interfere to some extent. For example, discrimination ratios for water (H_2O) and carbon dioxide (CO_2) are 3.5 percent H_2O per 7 ppm CO and 10 percent CO_2 per 10 ppm CO, respectively, for devices measuring in the 1,500 to 3,000 ppm range. For devices measuring in the 0 to 100 ppm range, interference ratios can be as high as 3.5 percent H_2O per 25 ppm CO and 10 percent CO_2 per 50 ppm CO. The use of silica gel and ascarite traps will alleviate the major interference problems. The measured gas volume must be corrected if these traps are used.

4. Precision and Accuracy

4.1 Precision. The precision of most NDIR analyzers is approximately ± 2 percent of span.

4.2 Accuracy. The accuracy of most NDIR analyzers is approximately ± 5 percent of span after calibration.

5. Apparatus

5.1 Continuous Sample (Figure 10-1).

5.1.1 Probe. Stainless steel or sheathed Pyrex¹ glass, equipped with a filter to remove particulate matter.

5.1.2 Air-Cooled Condenser or Equivalent. To remove any excess moisture.

5.2 Integrated Sample (Figure 10-2).

5.2.1 Probe. Stainless steel or sheathed Pyrex glass, equipped with a filter to remove particulate matter.

5.2.2 Air-Cooled Condenser or Equivalent. To remove any excess moisture.

5.2.3 Valve. Needle valve, or equivalent, to adjust flow rate.

5.2.4 Pump. Leak-free diaphragm type, or equivalent, to transport gas.

5.2.5 Rate Meter. Rotameter, or equivalent, to measure a flow range from 0 to 1.0 liter per min (0.035 cfm).

¹ Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

APPENDIX 7-6

PUBLIC CONSULTATION PROVISIONS

APPENDIX 7-6

PUBLIC CONSULTATION PROVISIONS

1. EMISSION LIMIT SETTING

As noted in Appendix 7-3, the Ministry intends to provide for public consultation in the process of setting enforceable emission limits, including Standard Operating Procedures. The Ministry hopes to receive comments relating preferences or proposals addressing how this might be done in a fashion which will provide for meaningful input while avoiding unnecessary delays in the establishment of new emission limits.

As also stated in Appendix 7-3, emission limits will be published in the Ontario Gazette and will not be finalized until 30 days have passed without any interested party initiating an appeal to the Environmental Assessment Board. The Board will decide whether to hear the appeal based on the merits of the written case presented by the appellant.

Where an appeal is granted, a public hearing will be conducted to determine what emission limits should be set for the source under consideration.

2. ISSUANCE OF CERTIFICATES OF APPROVAL

The Approvals Branch has been charged with the task of establishing triggering criteria for approvals warranting public notification and information programs. These remain under development at this time. Such programs would be run at the expense of the applicant, i.e., the proponent would bear the expense of running advertisements for notification purposes and holding public meetings to inform the public of the proposal and gather community reactions so that concerns can be addressed. The proposed program, the reactions received and how they were handled must be submitted to the Ministry for review and approval. The Ministry is committed to public consultation in all phases of its activities.